TELEPHONE ENGINEER

Vol. III CHICAGO, MARCH, 1910 No. 3

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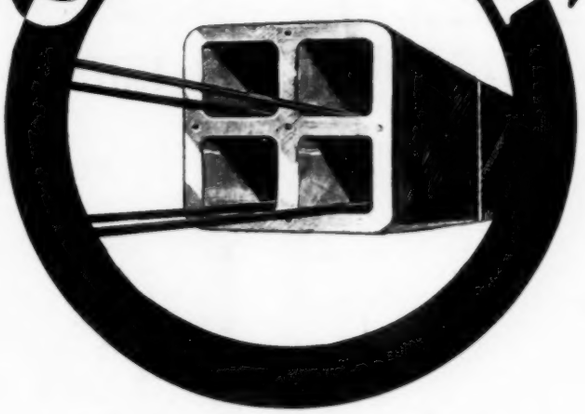

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TELEPHONE ENGINEER

VOL. III — CHICAGO, MARCH, 1910 — No. 3

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EXCLUSIVE CONNECTION CONTRACTS.

THE Slate Belt Telephone Company, operating in Slatington, Pennsylvania, and vicinity, has for some time enjoyed the benefits or suffered the consequences, as the case may be, of an exclusive contract agreement with the Bell Company operating in that territory. In order to secure this exclusive relation the Slate Belt Company found it necessary or expedient to turn its back upon its old friend and co-operator, the Consolidated Telephone Companies, with whose system it formerly connected, and summarily sever those connections. Furthermore, it is alleged, the exclusiveness of the Slate Belt-Bell contract was such that while the Bell might connect with other than Slate Belt lines, the Slate Belt could not connect with any but Bell lines. To which conditions the Consolidated companies bore witness in a complaint to the State Railroad Commission. In answer, that body has announced its first telephone decision.

The Commission has ruled that exclusive connection contracts are illegal, and strongly recommends that there be an interchange of local business between operating companies. In its decision, written by President Nathaniel Ewing and concurred in by the other commissioners, the state body says:

> The convenience of the patrons would be best served if the lines of all telephone companies were connected and each subscriber of every company thus furnished the facility for telephone service to all points on all lines from his own telephone, and not be compelled, as at present, to maintain a number of telephones if he desires general service. Some difficulty may be experienced in making this arrangement with respect to local service when there are competing local lines, but some reasonable basis for the interchange of local traffic can certainly be found.
>
> The exclusive connection contract is illegal and invalid and plainly violative of the oft-declared policy of the state, that all public service corporations shall not discriminate in their service of charges and shall conduct and interchange business with all similar companies.

The decision quotes at length from the general corporation act of 1874 and declares that it has been held by the courts that its restrictions upon telegraph companies apply to telephone companies.

Of course a "far-reaching effect" was immediately prophesied for this decision. Possibly there will be such an effect; it is difficult to estimate how many exclusive contract arrangements may be in force in Pennsylvania. But the report does not order universal connection; it only recommends it. So the Bell Company and the various independent companies will go on interchanging business or refusing to interchange business according to their lights, as before. They will continue to be exclusive if they approve of that relation. All they have lost is the validity of their exclusive contracts.

And that is little loss. The exclusive contract has

become a dead letter anyway; for nobody wants it. It is a relic of the uncompromising days when an operating telephone company had to be either virulently Bell or venomously independent; when warfare came before business and efficiency of service was secondary to effusion of sentiment. Today the aim of the practical operator is to give his subscribers the best service, and the broadest service that his equipment can yield or his lines can reach. If in the pursuit of this object he can use his neighbors' lines, so much the better; he cannot hope to build them all himself. And if, in turn, the neighbor uses lines beyond, they are but links added to the chain of universal service, of which he forms a part. He cannot afford to bind himself by contract to refuse the use of lines which may be demanded by the public, whose servant he is. The wise operator has long since learned to steer clear of exclusive contracts. The State Railroad Commission of Pennsylvania has found them legally wrong; but they were found economically wrong long ago.

SINCE WESTERN UNION CHANGED HANDS.

THERE is no quicker way for a public-service corporation to disarm popular criticism of its newest activity than to make that activity develop into a better service. When the improvement in service means also more business for the corporation, or less expense, or both, it should indeed be a happy corporation.

The recent affiliation of the American Telephone and Telegraph Company and the Western Union Telegraph Company brought forth much adverse comment, especially among ill-informed persons who regarded the two concerns as competitive, and hence legally ineligible to combination. It seemed that the irritating qualities of the term "trust" had been aggravated by the addition of one more grasping monopoly to the large and growing list. Followed the usual gloomy predictions of boosted rates and insolent service, if the latter term be not anomalous; for to the lay mind the only object of combination must be the removal of the restriction which competition places upon price and upon arrogance. Of course no such condition ever existed, nor could exist; for telephone and telegraph are never competitive, but always co-operative where we allow them to be.

It is hard to argue with the public at large, just as it is hard to turn a mob by logic. So while the telephone-telegraph combination was perhaps never near enough to the people to be seriously considered as dangerous, it was a peculiarly happy circumstance that allowed two immediate improvements in service, both calculated to put the wire-using public in an excellent humor and to bring much new business to the new owners of the Western Union telegraph.

The first of these improvements, the so-called "night-letter," is destined to be the most popular service a purely telegraphic institution ever offered. It at once frees the occasional and wholly informal user of the telegraph from the heart-rending restrictions of the ten-word message to which he feels it necessary to confine his announcement, however important; and it allows him to transmit that announcement—now grown to the respectable and almost verbose dimensions of fifty words—in quicker time than anything in the world but a wire would carry it. It gives him a choice by which, if he is willing to sacrifice a little of the quality of instantaneousness, he gains four hundred per cent in quantity.

The other improvement is still more interesting, for it involves the telephone, and knits firmly together in popular estimation those two twin carriers of intelligence. Those who have not yet acquired the long-distance telephone habit may still dictate their telegraph message over any telephone wire, and—Oh, wise provision—have it charged on the telephone bill instead of giving their change to the boy. And more, the telephone companies, which never sleep, will take the message in those hours when the little telegraph office is dark, and see that it gets through.

It is a little strange that the first radical improvements ever made in telegraph service should follow immediately upon the absorption of that form of utility by its little brother, the telephone. Some have said, after scanning the histories of both, that it was a case of the little fish swallowing the big. If the telegraph, under its new management, continues to develop useful versatilities, we shall begin to understand why the telephone has grown and spread apace while the older telegraph stood still.

MEASURED SERVICE.

IN the course of a recent talk to the Chicago Electric Club, Angus S. Hibbard made the somewhat astonishing statement that about one-half of all the telephones on the Chicago Telephone Company's system are of the nickel-prepayment type. He said it is the most popular service ever given.

It is hardly fair to the telephone-using public to assume that this affection for the spare-change telephone is due to the irresistable attraction which a slot exerts upon a United States coin of the proper size, although this peculiar affinity has been the means to more than one financial success in Chicago and other cities. Rather let us suppose that it betokens the general excellence of the measured-service method of rate making.

In spite of all pessimistic utterances to the contrary, the American public does not want something for nothing—or at least it has learned that it cannot beat the game. There is a wholesome atmosphere of fair play about measured service which assures the servee that he is paying for the talking he does, and not for some of what his more garrulous neighbor does. In short, measured service strikes the balance between the small user and the great, the single-barreled talker and the repeater.

To be sure, it has been argued that the measured-service system is weak in that it lacks mathematical perfection. It is not based upon the miles, feet and inches of wire which are placed at the disposal of the user for so many minutes and seconds. Neither, for that matter, does it take into account the abnormal amount of electric current consumed when the transmitter carbon is unduly compressed by the basso profundo of one user, for part of which current another gentler and tenor-toned user must undeniably pay. We submit that the true measured-service rate should be founded upon a milliampere-foot-second unit.

Another serious objection to measured service, and to all ordinary telephone service for that matter, is that it adheres too strictly to the doctrine that it is

more blessed to give than to receive. In consequence, the instigator of the conversation pays for the call, whether he confers or receives the benefits which should accrue from all well-regulated converse.

Doubtless, however, the further perfection of telephone etiquette will solve this difficulty by adjusting the sense of obligation, or at least by developing the sporting spirit of the telephone user. In time we may even become accustomed to hearing such conversations as the following:

"Let me pay for the call, my dear Alphonso."

"Nay, nay, Gaston! You paid for the last one. This is my treat."

"Well, just this once. But I owe you one, old chap. Let's have another. Set up the connections again, operator."

But the telephone is still young, and these obstacles to perfect service will be overcome in time. With all the faults we have enumerated, measured service is generally satisfactory service, both for the company and for the customer.

THE PEACE PROBLEM.

THE careful reader of TELEPHONE ENGINEER may recall that we had something to say last month about the futility of peace in the telephone business.

We have contended right along that it is time to do some forgetting. The telephone business is a good business and there should be a concerted effort to rid it of those things that have been harrassing it—the clash of opposing forces. The constant reiteration of error is menacing every interest. That there have been many faults is frankly acknowledged by everybody, so why drag them around.

The Bell company acknowledged competition long ago. It fought for its vaunted sacred right of a monopoly system and it lost. It stands today for a universal system—an open secret. The independents have made their presence felt all over the United States. They have been supported by the citizens of the town and village, the county and precinct—the plain, common people. They have extended the influence of the telephone with credit and have brought its far-reaching blessings to those who had the greatest need for it. Both the Bell company and the independent companies have been necessary in spreading the use of the telephone. There is a great work ahead for both factors.

When the Bell company offered to connect with the independents, the operators of independent exchanges should have known that a new order of things would have to be reckoned with. When the Western Electric Company offered to sell its apparatus to everybody, the independent manufacturer should have known that there was a new problem to be solved. Looking back over the three years since these new conditions have existed, we must conclude that the mere announcements on the part of the Bell and Western Electric companies were intended seriously as peace overtures. No one believed it then, because the Bell company had bad standing with the independents. The Bell company, by reason of its size alone, was "in bad" with everybody but itself, and by reason of its long conflict with the independents it could not and probably did not expect a cessation of hostilities.

The panic played its disastrous part in the program. How much evil is due to the temporary hard times will never be known. We do know that the Western Electric Company, discredited among all independents, invaded a market with no knowledge of conditions and were harshly, if not meritoriously dealt with. In retaliation, the company resorted to price-cutting and added demoralization to a market already staggering under abuses traceable to those who enjoyed its exclusiveness. There are no telephone manufacturers—either Bell or independent who are not familiar with the results. The great and glorious game was literally "shot to pieces."

Among the operators there has been saner methods. The conventions have been void of drastic anti-Bell resolutions. There were some so-called leaders of the cause enjoying subsidies from certain independent manufacturers, who stirred up some old-time resolutions in the outlying districts, but in the main, the inter-connecting agreements that were submitted by the Bell company were looked into. Even in this work, there were some bad arrangements, but the men who accepted the plan did it with their eyes wide open. Life isn't a mere trick. The best of us make mistakes and in negotiating a brand new wrinkle, the best of us will let our foot slip. Interconnecting has been going on quietly and there are some people who are being benefited. It isn't logical to presume that such an arrangement will work only one way—the Bell way.

We are believers in a competitive system of telephony. We are believers in the good judgment of telephone men. No business as a whole can point to a brainier aggregation. No one crowd of men can "put it all over" the other crowd and keep it up. C. L. Norton was right when he suggested only recently that there should be a convention of all independently owned telephone systems. It would result in a convention of accomplishment as compared to which all others would pale. Vilification is hurting the game more than anything else.

We know only one comparison; that of the two belligerents who were to do battle with their fists. Some one suggested that the word "sufficient" be used as the signal to stop fighting. The men had been belaboring each other until they could scarcely move when one of them gave the signal. The other said to him, "I've been tryin' to say that for fifteen minutes; I forgot."

The telephone business has been a good fight for the innocent bystander, but it has also been a costly encounter for those who have furnished the sinews of war. Color-bearing at the head of a victorious army may have supplied an abundance of glory, but those who bore the flag of truce were not dishonored. Manufacturers and operators of telephone systems in America are sufficiently endowed with reasoning faculties to offer competition that will have for its basic principle the conservation and expansion of present investments, rather than an attempt at destruction of the whole fabric. There are countless thousands of places and uses for the telephone that have not yet been discovered. There are abundant facilities for manufacture not now being utilized and there is need for a tremendous amount of money for further development in the operating field.

Greater confidence in the business by those who are engaged in it will start some idle wheels and bring some sheckels to the famished coffers of the operator who would like to make some needful expenditures. Let the serious minded men do some forgetting. It will help.

FEATURES OF COMPOSITE WORK.

THE imposing of telegraph duties upon an existing telephone toll circuit is, of course, an economy. How broad this economy may be, however, probably will not be realized until the owners of the toll line

have struggled through a series of new maintenance problems surprising to the inexperienced, and have found that the unexpected extra labor performed solely in behalf of the telegraph has improved the telephone transmission in a marked degree.

The telephone is possessed of a very remarkable vitality in operation. Delicate and sensitive as its instruments and principles are, it will talk through conditions that would completely paralyze any other manifestation of electric energy. Conversation has been carried on over lines wholly devoid of insulation and even partly submerged in water, that would not transmit any signaling current whatever. And this very quality of the voice-current makes the operative condition of a toll line too elastic a factor for safety, when its maintenance at a high grade depends wholly upon the elimination of reported trouble.

But the telegraph has no such vitality. Its demands are exacting and its requirements of maintenance much higher. It does not wait for falling wires or crossed circuits before flying a distress signal. It necessitates preventive rather than curative methods. A composite toll circuit must be tested frequently for insulation and for minor faults that would perhaps pass unnoticed on a telephone line. Such faults, too, must be more thoroughly corrected; breaks must be repaired very carefully and weaknesses of insulation strengthened at once.

All this extra vigilance, however, has its immediate reward. Line troubles are discovered at once, and need wait for no report from the chief operator; and the ultimate result will be the elimination of much trouble of that character. Neglect of toll-line maintenance exists merely because it is possible. With a composited line it is not possible. In short, compositing makes first-class toll lines.

ON RATES.

WHEN an independent and a Bell system operate in the same community, it is usually the independent which has the lowest rates—unless the Bell happens to be conducting one of its old-time campaigns for monopoly. The independents have, in fact, made a boast of their low rates, some specific examples of which they are now beginning to regret.

The original independent campaign was largely founded on low rates, for two reasons. The first was that a low price is commonly supposed to make the strongest possible appeal to prospective patrons; and the second was that the majority of the independent promoters honestly believed the proposed rates would be amply remunerative. In the light of present knowledge, both these theories were wrong. It has been proven time and again that high quality and high price find a quicker market than low quality and low price. A low figure in itself creates suspicion of quality, whether the commodity be shoes or telephone service. And where too low rates do not mean poor service—and they have rarely meant that with the independent operators—they mean unprofitable business.

Where competition exists, the inadequate rates of one company work a hardship upon the other beyond the mere matter of securing patronage. Unless the company with the low-priced service be able to prove that it is losing money, or appeal can be taken to a regulative commission, its rates will surely be accepted by the local authorities as a criterion by which to judge the other company, which will suffer correspondingly, at least in public opinion.

Independent companies have been formed in most cases as a means of relief from an inefficient or inadequate Bell service. It is regrettable that their promoters did not seize the opportunity presented by the discontent of existing telephone users, and start service at a rate even higher, rather than lower than the Bell rate. Those who were already accustomed to paying well for poor service would not have hesitated to pay more for better service. But the independents, generous to a very serious fault, gave the users better service, more connections, and lower rates all together.

It is not easy to untangle the skein that the immediate necessity for better independent rates has woven. Undoubtedly, the way to raise rates is to raise them. But the public is generally lacking in gratitude, and refuses to make the work easier. Unfortunately not every state has a regulative body like the Wisconsin Rate Commission.

There is a warning in all this common-place history to the new independent companies which are constantly forming as the crossroads become villages and the villages become towns. Let them be sure they have made ample allowance for all ordinary and extraordinary expenses, as well as a good round profit, before they decide finally on their rates. It is better to have a hundred subscribers and some profit, than a thousand and none.

REQUIREMENTS OF RAILWAY TELEPHONY.

THE rapidity with which the telephone has gained the esteem of proverbially conservative railroad men might lead the novice in railway telephony to suppose that its requirements are of the simplest, excelling commercial telephony in that respect. As a matter of fact, however, an even higher order of equipment, if not of engineering, is required in the former than in the latter. An operating company can get along very well, if need be, with apparatus and construction that could not properly be designated as first-class; but not so a train-dispatching system. Apparatus, wires, protective devices, even the poles must be better than is customary with either telegraph systems or operating telephone plants.

George H. Groce, assistant to the general manager of the Illinois Central Railroad, said before a recent meeting of the Central Association of Railroad Officers:

"My personal experience to date indicates that the best train dispatcher's circuit is composed of a pair of copper wires, each weighing 210 pounds to the mile, generally transposed every half mile, but having more transpositions when in the neighborhood of high potential alternating current electric lines; good telephone instruments installed upon the bridging principle; taking the two main wires only into offices thirty or forty miles apart for dispatching purposes; the calling apparatus to be on a separate 6-gauge iron wirer, both circuits to be provided with lightning arresters which will really protect the instruments and their users; induction coils and the coils of the transmitters and receivers to be of the best possible construction and better than is generally furnished in the ordinary commercial telephone. Experience has shown that the use of what is known as the impregnated coil serves to protect against the effects of lightning. The induction coil, which is an important part of the installation, should have a primary winding of about three-tenths of an ohm in resistance and a secondary winding of about fourteen ohms in resistance."

Exchange Development in New York

By J. H. Philips

TWENTY-two years ago there was no building in New York City specifically designed to accommodate the switchboards and apparatus necessary to furnish telephone service to the public. The central offices then in use were located in rented quarters, and were very small, each caring for only a very limited number of stations. That part of Manhattan Island south of Chambers street was cared for by seven small exchanges, known from the streets on which they were located as Nassau, Pearl, John, New, Murray, Beaver and Fulton.

In 1888 the New York Telephone Company decided to merge these seven small exchanges into one exchange district and erect a building capable of housing the offices of the company together with a switchboard large enough to care for future growth in the district. The building was located at 18 Cortlandt street and was an eight story brick and steel structure. This was the foundation of that remarkable group of buildings now occupying almost an entire city block, with a total floor space of over 250,000 square feet, in which are located the executive and general offices of the New York Telephone Company operating throughout New York State and in parts of Pennsylvania and New Jersey, and the New York offices of the American Telephone and Telegraph Company, as well as the New York offices of a number of subsidiary companies operating in various parts of the country.

New York Telephone Building from Dey Street Side.

It had been supposed that the large eight story building at 18 Cortlandt street would accommodate the offices of the company and its down town exchange for many years to come. However, it was only a beginning—a link in the chain of buildings now extending from 14 to 24 Cortlandt street and through to 9 to 17 Dey street. The growth of the telephone business in New York was rapid and in 1893, five years after the establishment of the big Cortlandt street central office, it was found necessary to open a new exchange to care for the development in the lower part of the Cortland district. The Broad exchange, opening January 1, 1894, relieved the heavily taxed Cortlandt exchange and allowed the latter space for further development in the now smaller district. The telephone business continued growing and in 1897 it was found necessary to erect another building. This building was 12 stories high and was located at 15 Dey street, immediately in the rear of the first building. The number of subscribers in the Cortlandt district increased rapidly and in April, 1898, a new exchange district, under the name of John Street, was formed out of the northeastern section of the old Cortlandt exchange territory.

Under the impetus of the improved service and able management, the business grew with such rapidity that still larger quarters were soon needed, and in 1900, a story was added to the original building at 18 Cortlandt street

and another building, its exact duplicate, nine stories high, was erected alongside at 14 Cortlandt street. The large amount of floor space available upon completion of this building was soon occupied and more space was in demand. In 1904 an extension nine stories high was added to the rear of the building at 14 Cortlandt street and in 1905 a new sixteen story building was erected at 22 Cortlandt street. In the same year a fifteen-story building was constructed at 9 and 15 Dey street and there floors were added to the older twelve story building standing beside it.

Operating Room, Cortlandt Street Exchange.

Since then, no additions have been made to this group of buildings. The constant demand for space, however, has been satisfied only by leasing a large portion of the Havemeyer building at 26 Cortlandt street, alongside the telephone company's group. All the buildings in this group, including the Havemeyer, are intercommunicating.

On January 1, 1910, in addition to its Dey street offices, the New York Telephone Company opened local accounting and collection offices at 115 West 38th street, 127 West 125th street and 366 East 150th street, New York. A large number of accountants and collectors, formerly located in the Cortlandt street group of buildings, have removed to the above addresses. The space made vacant by these removals, however, remained vacant only so long as it took to move in other departments of the company, as the demand for floor space has not abated.

As already stated the Cortlandt exchange as a consolidation of the former exchanges of Nassau, Pearl, John, New, Murray, Beaver and Fulton, was opened on October 28, 1888. The territory then served was bounded by Chambers street, New Chambers street, Park Row, Nassau street, Pine street, Hanover street, Albany street and the North river, and the original equipment consisted of a magneto, complete multiple switchboard with a capacity of 5,000 lines, in 43 sections of three positions each. This equipment carried the service until November 2, 1901, when the original Western Electric common battery, relay switchboard was installed. It was of the full multiple type and could accommodate 9,000 lines.

The next change came in 1906 when 2021 lines and 4972 stations were transferred to the new Rector exchange, which was established on March 10. Telephone development in the Cortlandt exchange district continued to be so great that in November, 1908, another transfer of lines had to be made; 1147 lines and 2284 stations being swung into that part of the Rector board which is know as Barclay. The Cortlandt exchange still has 9,000 lines, about 8,000 of which are in operation. In the fall of the present year it is planned to make another transfer of 300 lines to Barclay.

The Rector exchange, which was opened March 10, 1906, was equipped with a common battery, partial multiple Western Electric board of 5,600 lines, and 1039 lines from the Broad exchange were transferred to Rector, in addition to those from Cortland. The new board had 58 "A" positions and 34 "B" positions. There were 1184 incoming cords. In November, 1907, the "B" board was equipped with guard signals, and in June, 1908, the first addition of 1,600 lines was completed. The board at present accommodates 7,200 lines, about 6,100 of which are in operation.

The Jersey toll board was opened sometime in the early nineties and at present consists of 102 line positions, only 42 of which are in operation.

Commission Control Bill in New York

From statements made recently it appears that a bill providing for the placing of all telephone and telegraph companies operating in the state of New York under the supervision of the public service commission will be introduced in the legislature during the present session. This bill, as applying to telephone corporations, was favored by Governor Hughes in his recent message.

The step is to be taken as a result of legislative investigation of these corporations, which inquiry has been in progress for some time under the auspices of a committee appointed last year.

The committee, it is said, has demonstrated to its members that public interests would be best served by putting telephone and telegraph companies of the state under public service board control.

By this measure, should it become a law, not only would the Western Union Telegraph Company and Postal Telegraph systems be placed under the commission, but the American Telephone and Telegraph Company, which controls the Bell telephone system of the state, would be placed in a similar position. The numerous independent systems throughout the state would not be exempt from the measure's provisions.

Telephone System of Uruguay

Consul F. W. Goding supplies the following telephone statistics for Uruguay: Montevideo Telephone Company, 10,727 miles of wire, 4,105 telephone receivers, 227 employes, 4,036 telephone stations in city; charge per month—offices $4.86, residence $4.14; country lines, 1,040 miles of wire and 558 stations. Co-operative Telephone Association of Montevideo, 4,500 miles of wire, 94 employes, and one central station and 10 substations in city and country.

Rignoux-Fournier System of Television

By Fernand Honore*

IN the present state of science, the solution of the problem of vision at a distance by means of electrical transmission appears to be only a question of money. Researches in this field are directed toward the utilization of a peculiar property of the element selenium, which conducts electricity more or less readily in proportion to the intensity of the light which falls upon it. Upon this property is based the system of electrical transmission of photographs which was invented by Prof. Korn, of Munich, and which has for several months been in regular operation between the offices of the *Daily Mirror*, in London, and *L'Illustration*, in Paris. The general arrangement of Korn's apparatus has already been described in the *Scientific American*. The photograph to be transmitted, a negative film, is wrapped round a cylinder, which is caused to rotate before a source of light so arranged that only a very small area of the photograph is illuminated at a time. The pencil of light after traversing the film, falls upon a cell of selenium forming part of an electrical circuit which extends to the receiving station. Owing to the property of selenium mentioned above, the current which flows through this selenium cell at any instant is proportional to the transparency of the negative film at the point traversed by the pencil of light at that instant. At the receiving station this fluctuating current is employed to uncover, to an extent proportional to the instantaneous strength of the current, a lens which conveys a beam of light upon a photographic film carried by a cylinder which rotates in synchronism with the cylinder at the transmitting station. Hence the part of the film on which the beam falls is illuminated, and consequently blackened, to a degree proportional to the transparency of the corresponding part of the original film. In short, a negative at one station produces a positive picture at the other by the successive transmission of many small parts.

Instead of prolonging the operation in this manner, let us suppose that it is all done at once. Let us project the image upon a sheet of selenium divided into a very large number of small cells, each of which is connected with the receiving station by a separate wire. It is evident that in this way the entire picture could be transmitted at once and, consequently, that electrical vision at a distance could be realized. But in order to accomplish this, thousands of wires, each connected with appropriate apparatus, would be required, and the expense incurred would probably be out of all proportion to the value of the results obtained.

This theoretical scheme has not formed the basis of any practical experiments which have yet been brought to public notice. It was announced a few months ago that E. Ruhmer, the well-known electrician of Berlin, had solved the problem, and that his apparatus, costing an enormous sum to construct, would be the principal attraction at the Exposition at Brussels in 1910. No details of the apparatus, however, have been published. We know that it employs selenium, but we do not know whether it uses one wire or many wires.

In this state of the problem, it seems particularly interesting to note the solution proposed by two French inventors, M. Rignoux and Prof. Fournier, some of whose experiments the writer has had the good fortune to witness.

Rignoux and Fournier have invented two types of apparatus. The first is designed merely for demonstration and necessitates the employment of many wires. It may be described, briefly, as follows: At the transmitting station an object (a large letter of the alphabet, for example) is strongly illuminated, and its image is projected by a lense upon a frame containing a number of selenium cells, each of which is connected with the receiving station by a separate wire. Each cell, and its wire transmits a current proportional to the brightness of the part of the image projected on that cell and the corresponding part of the object. At the receiving station these simultaneous currents of unequal intensity traverse an equal number of little coils, and thereby uncover the same number of little mirrors to an extent proportional to the strengths of the various currents. Beams of light reflected by these mirrors are projected on a screen, side by side, forming patches of various degrees of brightness, proportional to that of the corresponding parts of the object. With a very large number of selenium cells, wires, coils, and mirrors, it would be possible to transmit a picture with fine detail and many gradations of tone. The experimental demonstration which is actually made is summary and crude, but quite convincing. The multiplicity of wires is a serious defect, which the inventors believe they have found means of remedying in their second apparatus, which is in course of construction and is illustrated by the accompanying diagram. At the transmitting

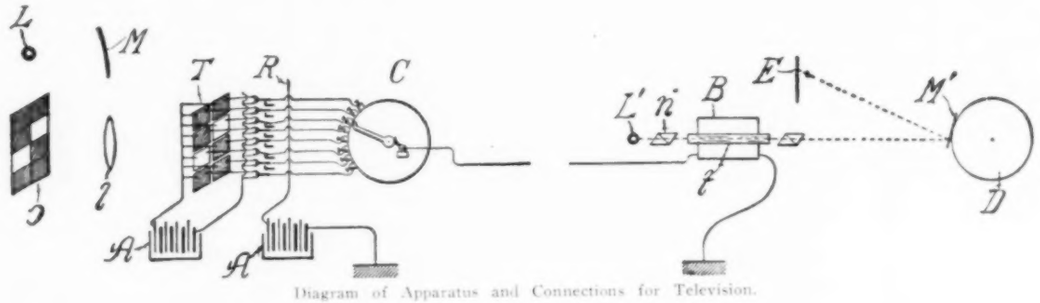

Diagram of Apparatus and Connections for Television.

*Courtesy of *Scientific American*.

station the rays of the luminous source L are reflected by the mirror M upon the object O, the image of which is projected by the lens l, upon the frame of selenium cells T. (The diagram shows a frame of eight cells and an object divided into eight equal squares. Two of the squares are white and their images illuminate the two corresponding selenium cells.) The very weak currents transmitted by the selenium cells are sent into the relay R, where they set into motion much stronger currents, the intensities of which are proportional to those of the selenium cell currents, to the illumination of the respective cells and to the brightness of the corresponding parts of the object.

The problem is, to transmit all of these currents through a single wire, without confusion, and to receive them, and cause them to act, separately and simultaneously, at the receiving station. For this purpose, Rignoux and Fournier have devised the following arrangement. The currents are conveyed to the contact pieces of the collector C, from which they are taken, successively, by a rapidly rotating wheel which is connected with the receiving station by a single wire.

Let us, for the moment, disregard the question of speed of transmission, and consider the means by which these successive currents are received.

At the receiving station the light of a source L', polarized by its passage through the Nicol prism n, traverses the tube t, which is filled with carbon disulphide, and then falls upon a second Nicol prism n', which is "crossed" with regard to the first prism. The tube is surrounded by a coil of wire B, which is connected with the wire coming from the transmitting station. Hence the currents which traverse the selenium cells for the transmitter flow successively through this coil and produce an electro-magnetic rotation of the plane of polarization of the light which is passing through the carbon disulphide, to a degree proportional to the illumination of the particular selenium cell which is momentarily connected with the line wire, causing corresponding fluctuations in the intensity of the light which emerges from the second Nicol prism n'. This beam of light of varying intensity falls upon the cylinder D, which rotates in synchronism with the collector C at the transmitting station, and which carries a number of mirrors, M', equal to the number of selenium cells. Hence each mirror reflects a quantity of light proportional to the illumination of a particular selenium cell and the brightness of the corresponding part of the object. The mirrors are so arranged that the light reflected by each falls on a different part of the screen E, on which is thus produced a mosaic picture, formed of patches of various degrees of brightness, of the object exposed at the transmitting station.

Is it possible to transmit and make *visible* in this manner, employing a single wire, an image produced by several thousands of selenium cells? Yes. There is no difficulty in constructing a frame of 10,000 or more selenium cells, each connected by a separate wire with a collector which comprises an equally large number of contacts. Now, if we remember that the frequency of alternation of an alternating current often exceeds 100,000 cycles per second, it becomes evident that 10,000 currents can be collected and transmitted successively over a single wire in a small fraction of a second. By the employment of 10,000 mirrors at the receiving station, an image composed of 10,000 patches of light can be projected within the same fraction of a second. The different parts of the picture will really be projected successively, but they will appear to be simultaneous, owing to the persistence of impressions on the retina of the eye, if the projection of the entire picture is accomplished within 1-40 second, and the apparatus can be so constructed that this process will be repeated indefinitely, giving the appearance of a persistent picture, instead of a fleeting glimpse.

Hitherto we have supposed the number of mirrors to be equal to the number of selenium cells. It may be found possible, however, to diminish the number of mirrors and to operate each mirror successively by the currents from several cells. This modification would doubtless involve complications and difficulties in construction which we need not discuss. For the present it suffices to show that the problem of vision at a distance, by means of a single wire connecting the two stations, has been solved by MM. Rignoux and Fournier. In the practical realization of the desired result the inventors will have to reckon with the phenomena of self-induction, interference, and the electric inertia of selenium, but these are familiar technical difficulties which will sooner or later be surmounted.

Effect of Tension on Conductivity

A paper by Dr. Sahulka, a German scientist, on the subject of "Effect of Tension on the Conductivity of Wires," is reviewed by *The Electrician* of London. The author described some tests carried out by him to determine the effect of tension on the conductivity of wires, and whether any alteration in the latter was due to an alteration in the former. Iron and aluminium wires were used and it was found, as a result, that there was no appreciable alteration in the conductivity due to tension so long as the elastic limit of the material was not exceeded. For practical purposes the effect, therefore, is not of importance, though for scientific reasons the results may be of interest. The alteration in the conductivity of wires under heavy load was, therefore, tested, the results being given below. The iron test wire was fixed to two terminals, and passed like a thread around a reel of non-conducting material. Weights were hung on this reel. A voltmeter was connected across the terminals, and an ammeter was also placed in the circuit containing the wire. While the current was being read the voltmeter was not in circuit. The primary length of the wire, whose diameter was 0.49 mm., was 1 metre, any alteration in length being determined by the position of the reel. Up to a load of 3 kg.—that is, 15.9 kg. per square millimeter—there was no alteration in the resistance. But an increase in this weight caused the elastic limit to be exceeded, and hence the conductivity and length of the wire continually to alter. To make certain of this, the wire was further loaded and readings taken. When a load of 11 kg. was reached, the length being then 1.08 times greater and the section 1.08 times smaller, the resistance was 1.16 times the original value. Similar results were obtained with another iron wire.

New Use for Telephone Wire

It is quite a common thing in the state of Washington, according to the Brewster (Wash.) *Herald*, for those who happen to need a piece of wire for mending harness and the like to appropriate portions of the local telephone system to supply their needs. The *Herald* calls its readers' attention to the fact that this procedure is apt to interfere with service on the line.

Characteristics of Phantom Circuits

By D. H. Braymer

SINCE by the use of phantom circuits it is possible by slight expense to make two toll circuits do the work usually done by three, the economies possible by the use of phantom circuits have made this subject vitally interesting to operating telephone companies. After years of extensive experimenting, apparatus has been developed which makes the operation of phantom circuits practical and satisfactory. It is the purpose of this article, therefore, to outline briefly the practical features of phantoming, without going into the origin and development of the phantom circuit. In a general way, however, it may be stated that the theoretical possibilities of phantom circuits were recognized about 1880, when the American Telephone and Telegraph Company began experimenting along lines which finally led to the elimination of various other schemes and to the development and practical application of the repeating coil for phantom toll circuits. It was not until after 1903, however, that the commercial use of phantom circuits reached any degree of prominence and became an important factor in the reduction of the expense of toll circuits. At this time there was under observation an experimental phantom circuit on the New England Telephone and Telegraph Company's line between Berlin, New Hampshire, and Portland, Maine, a distance of 105 miles. On account of the success obtained with this circuit, others were installed. Since then the use of phantoming has rapidly grown, and apparatus of such efficiency has been standardized that good results are obtained both in telephone transmission and signaling over long distances. One of the longest toll lines on which phantom circuits are succe-sfully operated at the present time is between Lansingburg, N. Y. to Buffalo, N. Y., a distance of about three hundred miles.

The theoretical diagram of the phantom circuit, using the standard repeating coil method, is shown on this page. The two metallic circuits are called physical, or side circuits, and the third circuit resulting from their combination is called the phantom.

Thus far in telephone practice the application of phantoming has been almost entirely confined to toll lines consisting of open wire circuits or of open wire circuits with but short lengths of cable. Its application to trunks connecting offices in an exchange district, and to switching trunks connecting a toll office to the local exchanges, has not been reduced to practice. This is due to the fact that these trunk lines are largely in cable, and also due to the fact that with the present methods of operating and signaling employed in the case of these lines, the use of phantom circuits would be expected to extremely complicate signaling apparatus and methods. In the case of subscriber lines, the use of phantom circuits has not at the present time been employed to any commercial extent.

The conditions attending the phantoming of the open

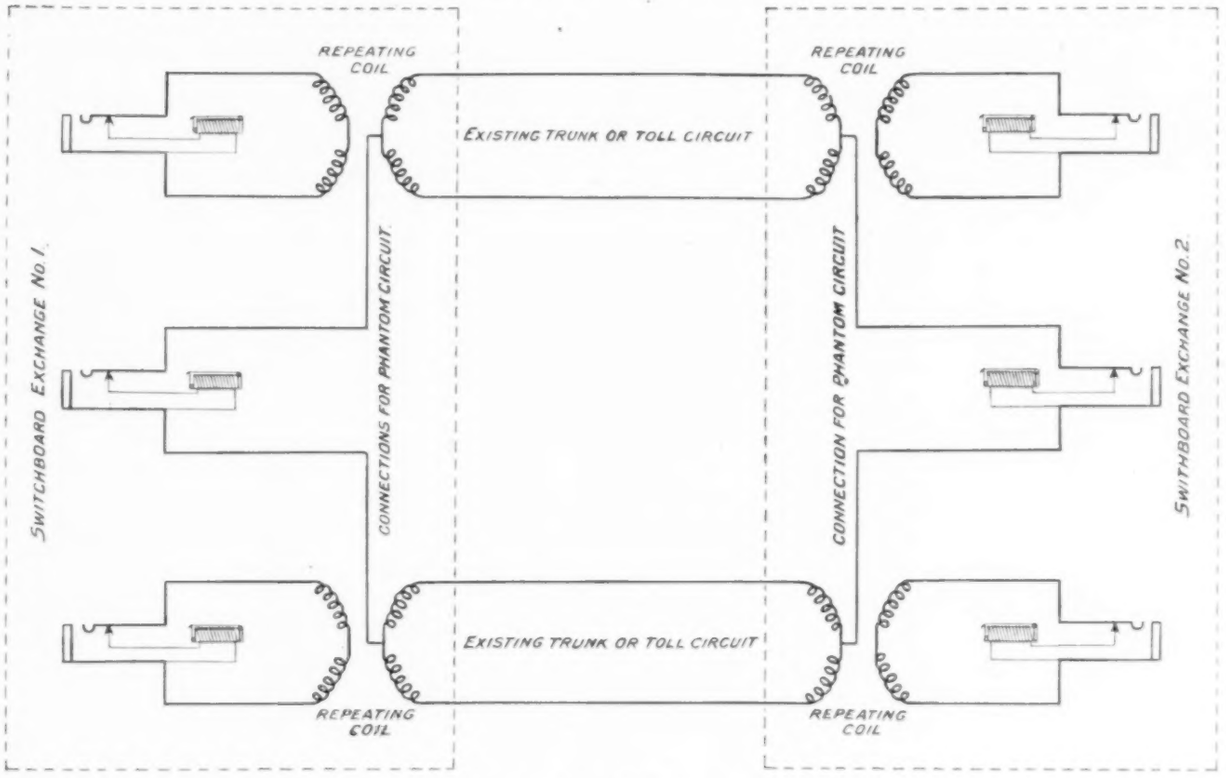

Diagram of Phantom Circuit Arrangement.

wire subscriber lines have made it necessary to adopt an entirely different system to that used in the case of toll lines. The comparatively small savings possible by the use of phantom apparatus on subscriber lines has to some extent discouraged its use for this class of service, but the principal reason is that the number of subscriber lines which can be phantomed is limited.

Of the classes of toll lines which can be phantomed, the best results are obtained when adjacent and exactly similar circuits are phantomed. By "adjacent" is meant circuits side by side upon the same cross arm, or those one vertically over the other. It is, however, possible to phantom non-adjacent circuits on the same cross arm. In general, however, this increases the difficulty of securing satisfactory transposition balance, and it is always undesirable to start the use of phantom circuits on a line by a more or less irregular practice, as when further phantoms are added the difficulty of transposing is increased for each additional phantom which it may later be desired to add.

Although, as already stated, it is desirable to phantom only similar circuits, that is circuits having the same gauge of conductor and of the same material, dissimilar circuits may, under most conditions, be phantomed without increasing the number of phantom transpositions beyond what would be normally employed.

The apparatus which has been employed in phantoming toll circuits and which has given the most satisfactory results are properly balanced repeating coils. Retardation coils have been used under certain conditions, but their use limits the operation of the circuits to a considerable extent, and therefore makes them, in general, not as satisfactory as repeating coils. Standard phantom circuit repeating coils manufactured by the Western Electric Company are used to a large extent for phantom circuits in the Bell system, on railroad circuits and in independent telephone systems. A large sized, high-ringing efficiency, high-transmission efficiency coil known as the number 37-A type is used on long lines where ordinary methods of signaling are employed. On comparatively short toll lines where maximum ringing efficiency is not required, another coil is used known as type number 39-A repeating coil. This coil has a high transmission efficiency and is especially designed for service on short toll lines.

With regard to phantom transpositions, a great deal of attention has been given to this subject, and detailed mechanical methods of making these transpositions have been thoroughly worked out. All transposition schemes depend upon the original transposing of the circuits which its is proposed to phantom, as well as upon the number of phantoms which are to be finally carried upon the same pole line.

Phantoming can be successfully carried out on circuits other than those used exclusively for telephone service; for example, circuits composited for Morse working can be at the same time phantomed and no difficulty experienced in the operation of the phantoms under such conditions. In addition to phantoming composite circuits, it is also possible to composite phantom circuits; that is, an independent telegraph circuit is operated over each side of the phantom circuit. These later applications are beginning to be used in the railroad field, and their use here will no doubt be very much extended.

Sign on Fifth avenue, south of Van Buren street, Chicago: "Shoes repaired while you wait or by telephone."

New Telephone-Telegraph Arrangements

Several new features for the convenience of the public are to be introduced by the Western Union Telegraph Company as the result of its alliance with the American Telephone and Telegraph Company. The first of these is a new service called the "night letter," whereby fifty words can be sent by telegraph at night for delivery early the following morning at the same price as the customary ten-word day message.

The next step will be to utilize the telephone as a collector of telegraph messages so that there will be no necessity of going in person with the written message to offices and paying the charges over the counter. It is planned that any telephone subscriber can call up a Western Union office, dictate his message and have it sent. The charges therefor will be rendered at the end of the month with the regular telephone bill.

This system will be tried first in Chicago, where the arrangements already have been made for the experiment. If successful there it will be established in other cities.

The company's official announcement concerning the "night letter" service is as follows:

"That in addition to the forms of service heretofore authorized, a 'special night letter' service be established as soon as practicable.

"The charge for this service shall be the standard day rate for ten words, for the transmission of fifty words or less, and one-fifth of such standard day rate for ten words shall be charged for each additional ten words or less.

"'Night letters' shall be written in plain English. Code language is not permitted.

"'Night letters' will be received not later than midnight to be transmitted only for delivery on the morning of the next ensuing day.

"'Night letters' may at the option of the telegraph company be mailed at destination to the addressees and the company shall be deemed to have discharged its obligation in such case with respect to delivery by mailing such message at destination, postage prepaid."

A greater part of the vast telegraph system, crowded to capacity during the day, lies idle at night. The new management figures that at small additional expense these idle wires can be made to earn something and also accommodate the public.

Messenger boy delivery, which is costly, is to be done away with by use of the post-office. The "night letters" will be placed in the local postoffice at point of destination in time for postmen to take them around on the first morning delivery of the regular mails. Where there are no free delivery messengers, the telephone will be utilized.

Another plan of great magnitude now being worked out is to have every city, town and village and even farmhouse in the entire United States in touch with telegraph and telephone communication at all hours of the day and night.

At present all telegraph offices, save those in the central parts of cities, close at 6 or 8 o'clock in the evening. Most of the world is cut off during the night. The telephone company offices everywhere, however, are always open for business. Anyone wishing to send a telegraph message after the Western Union office is closed can give it to the telephone company, which will transmit it to the nearest all-night telegraph office for transmission to point of destination.

How to Read Telephone Circuit Diagrams

By David S. Hulfish

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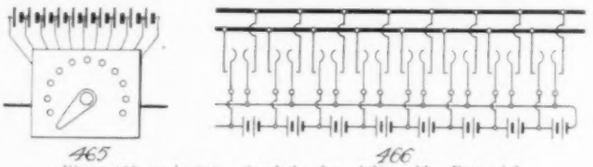
LESSON XIV.

THE draftsman in his work of making telephone circuit diagrams has been called upon often to show in the drawing some representation of electrical dimension. Simplest and most frequently of all it may be a matter of resistance and potential, ohms and volts; again, it may be inductance, capacity or current, henries, farads or amperes.

The only showings of absolute values in the circuit diagram, expressed in standard units of measurement, have been made by the use of figures set near



Figs. 465 and 466. Symbols for Adjustable Potentials.

the symbols for the different parts upon which the value is to be indicated. Relative values, wherein the diagram indicates that the dimensional value of one unit of apparatus is greater than the dimensional value of another unit of apparatus of similar nature, has been expressed frequently by differences among the symbols of the diagram, the symbols used being so modified for the different parts of apparatus that the interpretation of the distinction becomes manifest at once.

Symbols for potential or voltage are given in Figs. 10 to 16,* inclusive, and in Figs. 10 and 11 are shown two symbols representing potentials which differ from each other. As many different relative potentials as may be required for the purpose of any diagram may be represented by the number of times the cell-symbol of the preferred form is repeated in the representation of each voltage or unit of apparatus.

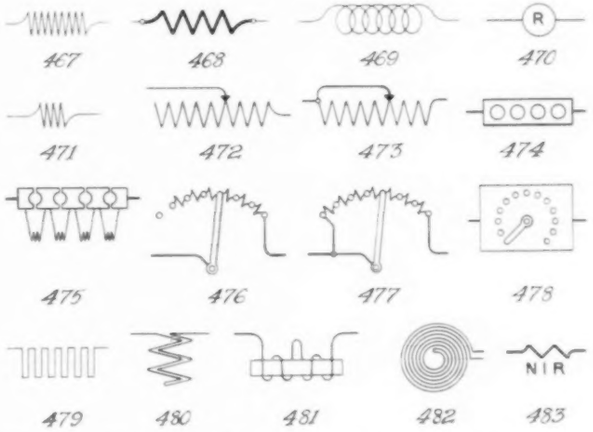
Symbols for adjustable potentials are not met frequently. Two symbols which have been used are presented in Figs. 465 and 466, each being in substance such a grouping of simple units as will effect the application to a circuit of a potential which may have a value adjustable at will. Fig. 465 shows a multipoint switch associated with a main circuit leading out at right and left, to which the potential is to be applied, and a set of battery cells leading presumably to the contact points of the switch, whereby any desired number of cells may be included in the circuit of the main leading-in wires, as determined by the position of the lever of the switch. Obviously, such a symbol may take a form analogous to that of the symbol of Fig. 472 or Fig. 476, the cell-symbols of the battery being substituted for the resistance symbol in its several parts.

In Fig. 466, a series of battery symbols is associated with a series of switch symbols. Since the operation of any two of the keys simultaneously would shortcircuit a portion of the battery, it becomes evident that but one key may be operated at any time, and since each key represents a different potential which may be applied to the main circuit at the top of the symbol, the entire figure may be regarded as an integral symbol indicating that there may be applied to the conductors at the top of the figure a potential of any desired value obtainable from the batteries at the bottom of the figure. Any potential applied from the battery to the conductors at the top of the figure may be readjusted to a new value by releasing the key used and operating another key corresponding to the new value desired.

A possible symbol for adjustable potential is the symbol for the dynamo (Figs. 398, 409, 413, 416) with a showing of a field coil (Figs. 393, 394, 395) adjacent to the dynamo symbol, with a battery (Figs. 10 to 16) and rheostat (Figs. 472 to 478), the battery and rheostat being in series with the field coil in a local circuit.

Resistance symbols commonly appear in the forms shown in Figs. 467, 469 and 470. Fig. 467 may be taken as representing a side view of a series of helical turns; Fig. 469 represents a perspective view of the same; in Fig. 470 the key to the symbol is the letter *R*, an abbrebiation for the word *resistance*, an abbreviation which sometimes is found *Res.*

Relative resistances are represented either (*a*) by a noticeable difference in the number of turns represented, or (*b*) by the thickness of the line representing the conductor, or by both methods combined. Fig. 467 compared with Fig. 471 will show a difference in resistance value according to the first principle; Fig.



Figs. 467 to 483. Symbols for Resistances, Simple, Adjustable and Non-Inductive.

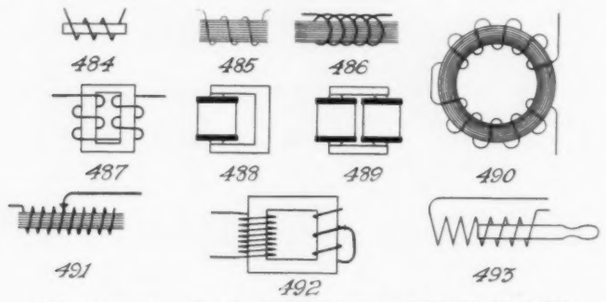
471 compared with Fig. 468 will show a difference in resistance value according to the second principle; Fig. 467 compared with Fig. 468 will show a difference in accordance with either or both of the principles, and usually both principles are observed in circuit diagrams.

The adjustable resistance or rheostat has its full quota of symbols in endless variation. Usually such a symbol comprises a showing of resistance and of

*TELEPHONE ENGINEER, January, 1909.

switch; see Figs. 475, 476 and 477. All detail of switch sometimes is omitted, abandoning all mechanical features and making a showing of electrical features only; see Figs. 472 and 473. On the other hand, the showing of resistance sometimes is omitted entirely, a showing of a switch alone being made; see Figs. 474 and 478. Motor starters (see Figs. 422, 423 and 424) usually involve the principles of symbols for adjustable resistances.

A distinction between the symbols of Figs. 472 and 473 exists in the attachment of the conductor leading in from the left. In the former figure, the conductor is not attached to the resistance element of the symbol except by its adjustable contact; in the latter, the conductor is permanently attached to the end of the resistance element, and in addition has its adjustable contact with that resistance. In Fig. 473, the value of the resistance may be adjusted from zero to the maximum for which the apparatus is designed, but the circuit can not be opened by any setting of the adjustable-resistance unit. In the device symbolized in Fig. 472, the circuit may be opened by moving the adjustable contact beyond the left-hand end of the resistance element. In Figs. 476 and 477 a similar distinction exists. A contact point is shown in Fig. 476 in isolated position at the left of the arc of resist-



Figs. 484 to 493. Symbols for Inductances, Simple and Adjustable.

ance contact points, to which isolated point the contact lever may be moved when it is desired to open the circuit through the device. In Fig. 477, the circuit is closed at all times, and may not be left open, even by accident or oversight. Each type of rheostat, therefore, has its advantages, and the distinction may bear weight in the study and solution of the diagram in which the symbol is found.

Fig. 475 shows a resistance in sections, any section of which may be short-circuited by a conducting plug inserted between the contact plates forming the row of elements across the top of the symbol; in this symbol also the circuit cannot be opened by intent or accident.

The symbol of Fig. 474 is a simplified showing of that of Fig. 475. The symbol of Fig. 478 is a simplified showing of those of Figs. 476 and 477; as to which one of them in particular, the symbol is noncommittal. Fig. 474 is met frequently; its wide popularity probably is due to the general use of plug switches for the variable resistances of Wheatstone bridges and similar testing devices.

Resistance without inductance, usually termed *non-inductive resistance*, is represented in the symbols of Figs. 479 to 483, inclusive.

Resistances not composed of wire, nor of long strips of conducting material, usually are considered non-inductive. Such resistances are ammeter shunts, carbon rods, telephone transmitters, extremely short wires, the planet earth, silicon crystals, metals in mass, etc.

To obtain a non-inductive resistance by means of wire, it is required that the current shall be given a path through the wire in such direction that the total of its passage in one angular direction about a real or imaginary helix core shall be equal to the total of its passage in the opposite angular direction. A resistance unit so constituted is termed a non-inductive resistance. It is prepared usually by joining the ends of two similar wires and then winding the two together upon a core or spool. The symbols of Figs. 480, 481 and 482 are based directly upon this method of manufacture.

Fig. 480 shows a side view of the double helix which this method of manufacture produces; the wires are joined at the bottom and the helix is formed by winding upward, the two outer ends of the wires being the leading-in wires or terminals of the complete non-inductive resistance. Fig. 481 shows the same structure with a view of the core, the wires being shown progressing each from the middle toward the ends; they may as well and even more logically progress from one end to the other of the core, giving a junction point at one end of the core and offering two free terminals at the other. Fig. 482 represents an end view of a helix begun with joined wires and terminating at the outside of the coil with two free wire ends.

The abbreviation *NI* adjacent to a resistance symbol indicates that the symbol is to be read as representing non-inductive resistance, while the abbreviation *NIR* adjacent to any symbol has a similar interpretation; this is indicated in Fig. 483.

The symbol of Fig. 479 appears to be purely arbitrary. It is easy for the draftsman's pen, and it is recommended by the United States Patent Office for use in diagrams forming parts of applications for patent. For these two reasons, the symbol of Fig. 479 is likely to have an extended use, despite the weakness resulting from its lack of inherent meaning.

For relative dimensions and for adjustable dimension, the principles discussed above with reference to resistances in general will be found to apply to symbols involving non-inductive resistances.

Resistance with inductance sometimes is embodied in a structure or circuit solely for the feature of its inductance. In such an instance, the inductance being the essential feature of the apparatus, the symbol emphasizes the inductive nature of the apparatus.

Figs. 484 to 493, inclusive, show symbols for resistances having inductance, or it may be properly said that the symbols there shown represent inductances.

Fig. 484 shows a core and a wire wound about it; this distinguishes from the simple resistance symbol of Fig. 467 by showing positively the fact that the wire is wound upon a core. Fig. 485 shows a core composed of a bundle of small wires; this type of core is used to increase the inductance of a helix, and a symbol showing such a core therefore emphasizes the inductive nature of the helix; Fig. 486 shows a similar construction, but varies the type of helix drawn upon the core.

Closed-magnetic-circuit inductance units are shown in the symbols of Figs. 487 to 490, inclusive. Fig. 487 shows a closed-circuit symbol of a type easily drawn. Fig. 488 shows side view of an electromagnet

spool with horseshoe keeper to close the magnetic circuit. Fig. 489 shows a pair of electromagnet spools with keepers across both ends to close the magnetic circuit. Fig. 490 shows the closed-circuit type of inductance unit using the closed core of small wires, the winding being shown in skeleton and showing the arrangement of turns; such a coil may have the two halves of its winding connected either cumulatively or differentially magnetic, the inductance value of the unit being variant in the two cases.

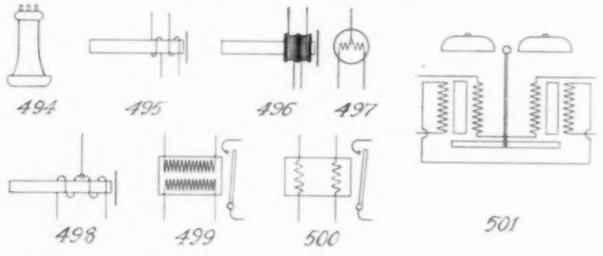
Adjustable inductances are shown in the symbols of Figs. 491, 492 and 493. In the device symbolized in Fig. 491, the inductance value of the device depends upon the number of turns which the current makes about the core, and this number may be varied by moving the adjustable contact. In the device of Fig. 492, the closing of the secondary or right-hand winding varies the inductance of the unit as manifested upon the primary or left-hand winding; by moving the adjustable contact of the secondary, the inductance of the primary winding is varied and adjusted.

In the device of Fig. 493, there is symbolized the adjustment by changing the quality of the core upon which the helix is wound. When a greater amount of iron is introduced into the open core of the helix, a greater value is given to the inductance of the unit as manifested in its helix. That the core is movable with reference to the helix is manifested by the shaping of the end to form a handle by which it may be moved. The attachment of levers to the core also would indicate a movable core and therefore a variable or adjustable inductance.

Relative values of inductance in separate symbols of a diagram may be indicated by variant numbers of turns about similar cores, or by variant positions of cores in similar helices such as that of Fig. 493.

The matter of differential and cumulative inductances, where a plurality of windings upon a single core are involved, has been discussed in connection with Figs. 258 to 264,* inclusive.

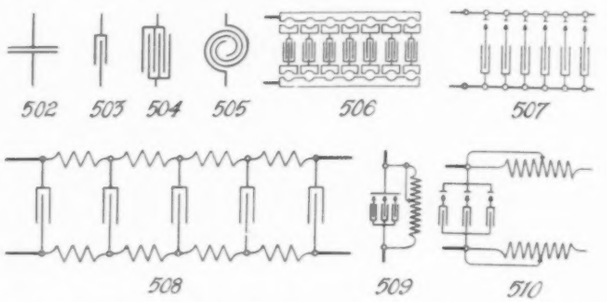
Differential inductances appear frequently in almost any type of electromagnetic apparatus. In such instances, where current through one winding is required to neutralize the inductive effect of current through another winding, the two windings usually are shown as nearly equal in appearance as possible,



Figs. 494 to 501. Symbols for Inductances Differentially Related.

although this has been by no means an absolute rule. A few symbols for differential units of apparatus are shown in Figs. 494 to 501, inclusive.

Fig. 494 indicates by the three terminals at the top of the receiver that there are two windings, one terminal being common to the two; whether the coils are differential upon each other at all times, or under certain conditions, the diagram reader is left to surmise, or to assume some condition which will be in harmony with the remainder of the diagram. In Fig. 495 the two coils of the telephone receiver are shown and their inductive relation is shown by the direction in which the wires pass around the core. In Fig. 496 the two windings are indicated by the septum between the spools, but the direction of the turns around the core must be assumed or gleaned elsewhere in the diagram of which this symbol forms a part. Fig. 497 also shows a symbol for a "split-wound" element of some sort, probably a "head telephone" or operator's small receiver. Fig. 498 shows a receiver symbol similar to that of Fig. 495, but with a "split" winding instead of two independent windings.



Figs. 502 to 510. Symbols for Condensers, Simple and Adjustable, and for the Artificial Line.

Figs. 499 and 500 show differential relays. In each of these relays the two windings which are supposed to neutralize each other are shown as nearly alike as the skill of the draftsman would make them, but the direction upon the core is not shown. The free-hand windings of Fig. 500 make that symbol an easy one to draw. Are not both of these symbols representative of relays with a repeating-coil function? The diagram in which the symbol was found must answer the question. The symbol in itself does not disclose this detail nor deny it.

Some fundamental principles in reading inductances may be studied in connection with Fig. 501. This symbol represents a polarized telephone call bell, each of the magnet spools of which is double-wound. The requirement of such a call bell when to be actuated by ringing current is that the upper end of one core shall be magnetically positive at any time and at the same time the upper end of the other core shall be magnetically negative. Taking the upper wire of the two wires entering the symbol of Fig. 501, it is seen that the circuit progresses downward along the left-hand core and upward along the right-hand core. The indication is that the entering end of one helix is the same in magnetic polarity as the entering end of the other helix, therefore that that magnetic polarity which is found at the upper end of the left-hand helix is the same as that found at the lower end of the right-hand helix, giving thus the proper magnetic condition for the operation of the polarized ringer. Taking the lower wire of the two wires entering the symbol, it is seen that the circuit of this wire progresses upward along the left-hand core and then downward along the right-hand core. Assuming that the magnetic polarity of the entering end of the helix of the second circuit is of the same magnetic polarity as the entering end of the helix of the first wire, it will be seen also that with current passing from left to right along both of the wires of the symbol the magnetic polarity produced

*TELEPHONE ENGINEER, September, 1909.

by each winding in either core will be opposing that produced by the remaining winding of that core.

The ringer of the symbol of Fig. 501 therefore is differential and unresponsive when equal currents pass from left to right or from right to left along both of the wires of the symbol; but when either wire carries a current and the other wire does not, the ringer will be responsive, and when the two wires carry currents which flow in opposite directions as they traverse the symbol the effect will be cumulative and each current will strengthen the effect of the other.

This principle may be applied in reading symbols of induction coils, such as those of Figs. 36 to 56,* inclusive. The interpretation of current values in coils of the inductoriums there shown may be expressed in the following rule: An increasing current flowing downward or to the right in any winding will produce by induction a current flowing upward or to the left in any and all associated windings. A decreasing current flowing downward or to the right in any winding will produce by induction a current flowing downward or to the right in any and all associated windings. This is the *general rule* to which all symbols of inductive relations *should conform*. Where the direction of turns about the core is shown, the inductive relation of the windings may be determined definitely. Where the direction is not shown, and where the above rule does not fit, it is merely a case of a symbol drawn by a draftsman who had either a little rule of his own or no rule at all. The reader of a circuit diagram has as his task the reading of the diagram as it has been made, not as it should have been made.

Simple condensers, the symbol of electrostatic capacity, are typified in Figs. 502 to 505, inclusive. The symbol of Fig. 505 manifestly is drawn to represent a rolled condenser. Comparing this symbol with Fig. 482, it will be noticed that the sole difference lies in the joining of the inner ends of the lines which in the one case represents the conducting wires of a helix and in the other represents the edges of the conducting sheets of the condenser.

Relative dimension of condensers is shown in the comparison of the symbols of Figs. 503 and 504; more leaves, rather than a longer leaf, is the key to the distinction.

Adjustable condensers are shown in Figs. 506 and 507. By the plug switch of Fig. 506, one or more of the condensers in the middle of the symbol may be connected across the leading-in wires at the left of the symbol. In Fig. 507, the condensers are permanently joined at one side to one of the leading-in conductors, and each has a switch whose mechanical structure is not disclosed by the symbol, by means of which any or all of the condensers may be connected across to the other leading-in conductor. An adjustable value of capacity thus is afforded.

An electric line of metallic circuit and having the features of distributed resistance and distributed capacity is symbolized in Fig. 508. Such a symbol usually is called the symbol of an artificial line, the physical line of a diagram being represented usually by an unbroken line, in accordance with the symbols for conductors.

Figs. 509 and 510 show symbols for an adjustable artificial line. In these symbols, the resistance and capacity are not distributed as in Fig. 508.

The symbol for an artificial line will be encountered in circuits wherein differential or balanced apparatus is included and wherein it is necessary that some local circuit carry a current at all times equal to the current passing over the transmission line. In such an instance, an artificial line, preferably adjustable in the symbol, is included in the local circuit, and this artificial line is adjusted to have approximately the same resistance and capacity as the physical line over which the transmission is being effected.

In its simplest form, the symbol for the artificial line becomes merely a resistance symbol and a condenser symbol in multiple.

(To be continued.)

*Telephone Engineer, February, 1909.

The Wisconsin Rate Commission

In the case of the Columbus Advancement Association vs. the Wisconsin Telephone Company the petitioners complained of discrimination in the telephone service. It was shown that the company listed certain parties at four-party line rates, yet furnished them with higher grades of service; in fact, investigation showed that only 148 out of 277 subscribers listed in February, 1909, were receiving four-party line service. Twenty-nine were receiving three-party line service, and 128 receiving two-party service. The decision of the Wisconsin Rate Commission upon this case was that while it is impossible to keep party lines filled, nevertheless the furnishing of higher grades of service than paid for to such a large extent as shown was a discriminatory practice. The telephone company was ordered to regroup its party-line subscribers in such a manner as to increase the efficiency of that kind of service.

The same petitioners also complained that the rates charged by the Wisconsin Telephone Company were excessive. The engineers of the Commission, allowing seven per cent for plant depreciation, found that the company had failed to return six per cent upon its investment, and a reduction in rates was not warranted. The Thompsonville Telephone Company asked for permission to increase its rate from $1 to $1.50. Authority was given for an increase to $1.25. The Oostburg Telephone Company petitioned an increase from its uniform rate of $1 to rates calling for $2 per month for single party and $1.75 for two-party business telephones, $1.50 for single party line and $1.25 for two-party residence telephones, and $16 per year for rural service. The rural service is to be kept down to five-party lines where possible.

Bell Company Shows Big Growth

Two thousand new telephones a day were added to the Bell interests—the American Telephone and Telegraph Company—during the year of 1909. A statement issued by the company recently made more powerful by acquiring control of the Western Union Telegraph Company, claims that on December 31, 1909, there were about 5,000,000 telephones included in the system, with 10,250,000 miles of wire, more than half of which is underground. The total net property of the system on May 1, 1909, was valued at about $712,500,000, while the estimated gross earnings for 1909 will be in excess of $150,000,000.

In Siam the government owns and operates the telephones. A new installation was finished last year. It is of the central-battery system, arranged on the common-battery principle, for 1,500 subscribers.

What One Woman Thinks

By Sarah Elizabeth Brown

I RECKON it won't be necessary for me to make apologies for what I may choose to write henceforth, now that the thing has been settled between Obediah and me. If I "go wild," just "cut it" and use what you want. As a result of my first appearance I got my big shock when the postman handed me the letters that you forwarded. Really, I didn't expect to hear from anybody except Obediah. It hadn't occurred to me that letters might be sent to me in your care.

To the kind friends who have accorded me this recognition, I wish to say that this is not a query department. It isn't a place where troubles are to be "aired"—barring my own. I am to be unhampered in this work, or rather in the pleasure I've fixed in my own mind to have in this public way. My only "trouble" was anticipated in advance. I knew Obediah would kick, because that is a man's instinct and privilege and having settled that point in a woman's way, with the only man she has to answer to, I don't want any other encounters from outsiders.

The facetious scribe in Saskatchewan who wrote: "Go it, old girl, it takes the 'old women' to conduct the financial departments in telephone journals; the precedent is well established! You've landed at the opportune time in the perfectly proper place," has got me guessing. This is not a financial department, and while I may advance my own feeble sentiments on telephone money matters, I don't quite get our Saskatchewan friend's thought. I assume to be just ordinarily "smart." I confess to the sobriquet "old woman," although it goes against the grain, but I doubt whether in the eyes of telephone men generally Kelsey and Latzke would qualify in my class. I certainly am not trying to emulate them, and I am not "knocking." I have no axe to grind. I want to be left alone. If I must have letters, let them be in a friendly spirit with a motif to help a business that is good enough to warrant our connection with it. I am inclined to take umbrage at the implication that the financial departments of other telephone journals are in the hands of "old women." I am reasonably sure that my own interests, by virtue of Obediah's investments being largely in independent telephones, qualifies me to say something on finances. Whether the other writers have a nearer relation to independent securities remains to be seen. As I regard them, their utterances don't always ring true, but it is easy to criticize and I am not going to argue, if I can help it.

* * *

Obediah has had a very sad experience during the past month. It has brought him partly to my way of thinking, which makes it mighty hard for him. Let me tell you roughly about it. Ben Phelps owns practically all of the Bowtop Mutual System with nearly 600 stations. It is in fairly good shape. Our own "plant" has approximately 800 subscribers, a good, average country exchange. Obediah and Ben are old boyhood friends. They are real men chums. The capital stock of the two companies amounts to a round $100,000, with only a little "moisture." This stock has been paying four per cent semi-annual dividends for six years and there has been ample reservation for up-keep, but not enough to warrant a lively campaign for extensions. By joining the systems, they have figured that a more satisfactory service at an increase in the rate would follow. It was argued that a property as good as this would warrant a bond issue of $50,000. If the bonds could be floated, the money would be used in reaching out into the districts which want service, but for reasons needless to mention in detail, the requirements are neglected. Well, it took several visits back and forth between our home and the Phelpses. The men settled the terms of consolidation, dependent upon the success of the bond sale. They went to Chicago together, seeking a market for the prospective bonds. All of this business in actual practice was new to both of them. In their own homes, across their dining tables and in the bosoms of their own families, they had a "cinch." Tom Denning, the lawyer who drew up the papers, knew there would be no trouble in placing the securities. It was kind of him to encourage them. That's what they paid him for!

* * *

You see, Ben and Obediah, like thousands of other independent telephone men, are in the business because of two things: First, they like it and second, it pays. They are plain men bent upon making an honest living. Peculiarly, if not naturally, both have made their surplus investments in farms. Their business has thrown them in touch with local bankers, but they have had no relations with "the street."

Chicago is full of big banks that are full of money. With a perfectly child-like complacency and confidence these banks were visited. In no place could a banker be found who knew a broker who handled independent telephone securities. In one place they found someone who recalled that Trowbridge & Niver Company had placed an issue of bonds for the old Twin City Telephone Company, but that these brokers were now specializing particularly in irrigation projects.

* * *

The up-shot was no one could find a place for our bonds. The prospectus was largely a verbal affair backed by the sincerity of two men who find no difficulty in avoiding the police and who also had the record of earnings of the properties they represented. They also had the agreements of the stockholders. No one found a flaw in the plan. No one critized the wisdom of doing the thing proposed. As near as I can find out, everybody thought well of the enterprise, but offered no substantial encouragement. It wasn't necessary to print the bonds until there was a market.

* * *

After three days of parley and some warm personal encounters at their hotel, Ben declared that he would find out what was wrong. That morning, by appointment, they met a banker who listened with unmistakable interest to the proposal, but with the usual side-stepping, fade-away, glad-you-came demeanor. This was Ben's chance. He said with some heat: "What's the matter with our proposition, anyway?" We'll call our banker friend Smith. Mr. Smith, assuming his pleasantest manner, answered: "My friends, I really don't know. My own views—not subject to repetition—are based upon the gen-

eral assumption that all telephone securities are bad. I trust you will hear me with patience. You independent telephone people, according to the best information I have, are always discrediting the American Telephone & Telegraph Company's securities. Without exception, you denounce the Bell companies. In retaliation, the Bell company says that you are a lot of farmers who have by sheer accident broken into a business that requires great skill and technical knowledge; that you have builded badly; that your systems are nondescripts; that your apparatus is mere rubbish. The pro and con abuses that telephone men hurl at each other creates an extremely bad financial footing. The people who have money to invest will have nothing to do with telephone securities, because of this. The market is flooded with securities where the properties are free from such wholesale vituperation. In no other business does a like condition exist. It is doubtless very unfortunate for both interests, but as long as the condition remains unchanged, I am sure that telephone investments will not stand much of a show in the money market."

* * *

Of course, it wasn't exactly in those words, but I'm sure that between Ben and Obediah's metal versions, it was mighty nearly like that, for I fancy most of Mr. Smith's talk seared the flesh of both men. I never heard a Brown or a Phelps say a good word for the Bell company and it is reasonably certain that the Bell company has little use for us, because there are only nine Bell instruments in the two counties where we operate.

* * *

Obediah is a meek man. He was mad at brokers, banks and bankers till Mr. Smith told him the identical thing he knew. He is beginning to think that there must be a better way.

* * *

Did you ever hear of an abracadabra? I used to hear my mother tell about it. She was a southerner and had weathered some ravaging fever epidemics. An abracadabra was supposed to cure fever and ague ailments when worn as an amulet. The word is purely mystical. Its arrangement took the form of an equilateral triangle inverted, each line being shorter than the preceding one by the omission of the final letter of the word. The children were obliged to wear this word for nine days. It was crudely done on a piece of linen suspended from a thread placed around their necks. On the ninth day, they threw it off backwards, before sunrise, into a stream running towards the east. I am thinking that the word "telephonitis" should have some such mystical treatment. Let all the men wear it for nine days and then follow the plan that my grandmother prescribed for her children. Possibly after that the going will be better.

* * *

In my copy of the Chicago *Record Herald*, dated February 17, a special dispatch from South Bend says that Theodore Thorward had received information from Cleveland that the Continental Company had acquired options from J. P. Morgan & Company on their recent purchases in Ohio and Indiana. Land sakes! where will this muddle end, I wonder. We were settled down for a peaceful evening—Obediah and me, with a plate of apples on the center table. The children were at a party—all but Minnie, who had gone to bed—when I spied this new phase to an interesting situation. Obediah had just taken a big bite out of a Greening and I thought he would surely choke when I read the dispatch. You can imagine what kind of a talk we had. There wasn't anything we overlooked, from the time the independents started to fight for their rights till now. We've been over the thing time and again, but never any more thorough.

What I want to know is the real inwardness of this Continental crowd. I can't get head nor tail to it. Is it a really for sure independent move? Why don't you publishers enlighten your readers on a subject so vitally interesting? The thing that makes us all the more nervous, too, is the sudden ending of that inquiry of the minority stockholders of the U. S. Telephone Company. They started out to set aside the sale of their lines to Morgan—claiming restraint of trade or something like that—and before they had got good and started, they quit.

I was reading only a few days ago about Morgan owning about a twelfth of the earth, or maybe it was only the United States, it doesn't matter; but could he "fix" all the minority folks over night? I can't forget how he got all that property in Ohio and Indiana. It is a badly tangled up story, as sure as you're born, but it seems that Mr. Davison of the Morgan crowd attended to the details and he wanted J. Pierpont to know how far he had got. The amount exceeded $7,000,000 and Davison thought Morgan himself might be interested. He tried for several days to get the ear of his chief, and finally caught him at the curb just after he had stepped into an automobile. Through the auto window Morgan listened a half minute. Then he waved Davison aside with: "All right, go ahead with the deal and close it up. I'm in a hurry now to keep a luncheon appointment." Ho, hum! Ho, hum! what a headache! Mere trifle—$7,000,000—I'm in a hurry to eat! Can you beat it? No, children, Morgan isn't an independent telephone operator. He regards it as interfering with his meals, alright, but he doesn't miss a meal. When he will miss an occassional lunch he will be one of us, but I'm sure he isn't going to rub out his coat-of-arms and substitute the shield right away.

Exclusive Contracts Illegal in Pennsylvania

The State Railroad Commission in a decision announced February 12 in the complaint of the Consolidated Telephone Companies of Pennsylvania against the exclusive contract between the Bell Telephone Company and the Slate Belt Telephone Company of Slatington, Pa., rules that exclusive contracts are illegal and strongly recommends that there be an interchange of local business. The decision, which is the first to be given by the commission in a telephone case, will have far-reaching effect. The two lines formerly had an agreement, but later a contract was made between the former and the Bell which the complaint alleged prevented connections with any company except the Bell. In the decision the commission says: "The convenience of the patrons would be best served if the lines of all telephone companies were connected and each subscriber of every company thus furnished the facility for telephone service to all points on all lines from his own telephone, and not be compelled, as at present, to maintain a number of telephones if he desires general service." The commission holds that the exclusive connection contract is "illegal and invalid" and "plainly violative of the oft-declared policy of the state and that all public-service corporations shall not discriminate in their service of charges and shall connect and interchange business with all similar companies."

Who's Who in the Telephone Game

Facts and Fancies About a Man You Know or Ought to Know

WHEN you are only forty-three, and you've been going along with the same concern since you were fifteen, it means at least two things: You like it; and your people like you because you like it. Twenty-eight years is a good long grind, as grinding grinds, but in this case there were diversions. It wasn't like feeding a stamping machine—so many hours per day, so many days per week, so many weeks per year—nothing like that! There are many changes of scenery from the upper delta of the Kennebeck river to all over this country and beyond, and there are some differences between night operator at Bath, Maine, in 1882 to assistant chief engineer of the whole telephone works in 1910.

These Sandy Ones Do Move.

Strange, when you think about those twenty-eight years and the man who always stuck around to do those things that a big concern might want to have done. Stranger, that a good man—emphasis on the "good man"—would enjoy doing that, especially when the house was big—terribly big, to the point of having mean things said about it.

But the scheme has been the same during all of those twenty-eight years. The man wasn't any bigger than the scheme, but he was a match for it. The Scotch-Irish are noted for that whether they come in big hulks or in trim little packages—whether they wear whiskers on their hurricane deck or let them spread around over their shirt fronts.

These things are being said about James Lawrence McQuarrie. He started on the night shift for the Bell Telephone Company of Maine in 1882. The exchange had less than a hundred subscribers. He grew out of the lamp light of the night to inspector of the plant in day light. When the New England T. & T. absorbed the Maine company, McQuarrie was taken over as chief asset. He was transferred to Portland, where he continued to inspect. After a while, when he could point to the records as sure-footing for his successor, he accepted the management of the Portsmouth exchange in New Hampshire. If McQuarrie had by that time developed any traits of a rutter no one had noticed it. Things were so spirited under his management at Portsmouth that the engineering department at Boston got curious and sent for him. It's a habit they have in Beantown. This was in 1887. Going some, for a red-head of twenty. Well, have you forgotten that he started early and staid late? And isn't he S-c-o-t-c-h - I-r-i-s-h? For shure. During the following seven years he clung to the engineering department at Boston, and commenced to invent things. They say he never knew when to quit if he wasn't through. One time he went to sleep at the switch, or maybe he went to sleep in a switchboard—it was something like that, but he needed the sleep and it would be convenient to wake up right where he left off, so he slept there. That was before the telephone switchboard folding-bed had been thoroughly introduced in well-regulated exchanges.

By now, McQuarrie's inventions were coming along rapidly and Boston had to give him up. He came to Chicago, where he found a pleasant little nook, light over his left shoulder, in the Clinton street engineering department of the Western Electric Company. He keep right along, sleeves rolled high, nobody to fuss with—inventing, perfecting, maturing. Eleven years of it with fifty-five patents to his credit all relating to telephony. Still going. These sandy ones do move.

Then they wanted a "back east" assistant to the chief engineer and James Lawrence McQuarrie was conveyed back to the gold rooms in New York, where he is taking care of that next-to-the-biggest telephone job in this or any other country.

It has been a long grind. McQuarrie has achieved much for his house and much for himself. His assistance in the development of common battery equipment is probably his best work, but that is only incidental, for his work is all 100 per cent good. He was involved in the first c. b. multiple switchboard installation. The board was placed in operation at Worcester in 1896.

James L. McQuarrie was born at Bath, Maine, August 15, 1867. His education was cut short by his call to duty. You can't do the college stunt when you have to start to grind at fifteen. The public schools gave him what they could, which seems to have been adequate, because there are several hundreds of thousands of the frat crowd who have less to their credit than he has. He is married; he smokes; he plays

golf. Those things all help to leaven life's hurley-burley.

Ever play golf? Great game! The nineteenth hole is reserved for the college men—the other eighteen for the high school crowd. You see, the high school of the olden days didn't have lockers or showers. The colleges did. The college chaps—some of them—play the nineteenth hole. They don't need the lockers and the shower is applied differently on the plus-hole course. The public school chap plays the full eighteen holes—dashes his "weapons" into the locker, takes his douse, changes his clothes and emerges to face the day's work or a night's rest with all the vigor that the nineteenth hole destroys. McQuarrie is doing the best he can with the eighteen-hole course. He is emerging from the dub-class. Oh, those dub players—what an army there is of them. But there is a difference between golf and the telephone game. If you don't believe it, ask Mr. McQuarrie.

Paris Studying New York Telephone Methods

Monsieur Millerand, Ministere des Postes et des Telegraphes of the French Republic, has written to U. N. Bethell, vice president of the New York Telephone Company, asking if the New York company would be willing to take on six young telephone officials from Paris and give them a thorough practical training in all the branches of the telephone business. Mr. Bethell has advised the French minister that the New York Telephone Company will be glad to aid the French telephone administration in every way by receiving and showing every courtesy to the officers who may be delegated to come to New York.

In Paris the telephone service is run by the government, and for years the telephone service of that city has been in a badly disorganized condition to say the least. Visitors to Paris claim, and even the Parisians themselves admit that the telephone service there is execrable. The mismanagement which generally occurs in government-owned enterprises is said to be responsible for this bad condition of telephone affairs.

This is the view taken by the Paris correspondent of the *London Times*, who writes as follows: "During the last few years indeed the service has gone from bad to worse. Some scheme of far-reaching reform is imperative. * * * As has been pointed out over and over again by the parliament reporters of the post office estimates, a private enterprise were it to undertake to exist with such an organization as that of the present French telephone service would come to grief in six months."

Several years ago, telephone subscribers in Paris organized themselves into an association to endeavor to secure better service. This association has a large membership and has been working to accomplish the much needed reform.

To add to the difficulties of the situation, last summer the principal telephone exchange of Paris was completely ruined by fire. At that time it will be remembered the French government turned to this country for aid, and the exchange was re-equipped with Western Electric apparatus.

It is stated from Paris that under the administration of the newly elected minister of post and telegraphs, M. Millerand, the much-needed improvement of the telephone service in Paris is confidently expected. M. Millerand is taking hold of his work with unusual energy, and is endeavoring to re-organize the telephone service of Paris, in accordance with the best-known telephone practice.

That M. Millerand has selected the New York Telephone Company to train his young officials is considered by telephone men as a very high compliment to the New York telephone service, although, as a matter of fact, New York's telephone service is famed all over the world for its efficiency. Also the fact that a government ownership enterprise finds it necessary to send its officials to a privately owned corporation for training is an interesting commentary on the comparative efficiency of these two types of management.

Telephone Delivery of Letters

The unique plan of the London, England, post-office in telephoning the contents of letters on Sunday is described by Consul-General John L. Griffiths:

There has been for some years more or less complaint of the non-delivery of mail on Sundays in London. An arrangement has now been made by the British post-office by which letters posted in the country on Saturdays can be delivered in London by telephone on Sundays. The new arrangement goes into effect immediately.

When it is desired to have the contents of the letter telephoned on Sunday it must be inclosed in an envelope addressed to the Central Telegraph Office in London, and a broad line must be marked across the envelop from top to bottom. Postage stamps to the value of three pence (6 cents) for every thirty words must be forwarded. The postmaster-general states:

"The new scheme, while giving considerable additional facilities to the public to meet those cases of emergency which lead to the present limited demand for a Sunday delivery of letters in London, will add little or nothing to the amount of Sunday attendance by the post-office staff. The telephonists and others who will deal with the messages in London must in any case be on duty, the telephone exchanges being open all Sunday. On the other hand, there will probably be some reduction in the force now employed to deliver telegrams and express messages on Sundays."

It has been the custom to have a Sunday morning delivery of mail in England and Wales, outside of London, but not in Ireland or Scotland.

The arrangement that has just been made is the first opportunity that the citizens of London will have of receiving, in rather a peculiar way, the contents of letters posted too late for the last delivery on Saturday night. It is impossible to conjecture to what extent the telephonic delivery of letters will be used, as ordinarily the writer of a letter would perhaps not desire to make its contents known even to a telegraph operator. It necessarily destroys the privacy of a communication, but in cases of emergency would probably be employed.

Postal to Dispose of its Telephone Stock

Announcement is made in the annual report of the Mackay Companies, which control the Postal Cable Telegraph Company, that the company will sell its entire holdings of stock in the American Telephone and Telegraph Company "in defence to public opinion, which views with suspicion this large holding of stock in a company which has recently purchased control of the Western Union Telegraph Company."

Modern Automatic Telephone Apparatus

By W. Lee Campbell*

PRIOR to the year 1896, an automatic telephone subscriber called any number which he might desire by pressing push-buttons on his telephone. If the subscriber wished to call No. 143, for example, he would first push the "hundreds" button once, then the "tens" button four times, and finally the "units" button three times. While this arrangement gave passable service, the subscribers made many mistakes in counting the pushes and sometimes did not press a button in far enough or hold it in long enough. Consequently, in 1896, a button-pushing machine or a "calling device," as it is commonly named, was substituted for the push-buttons.

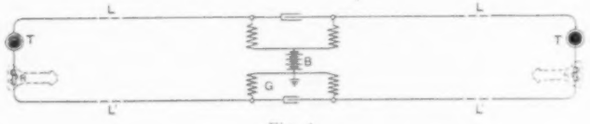


Fig. 1.

The visible portion of the calling device consists of a dial pivoted at its center so that it may be turned in a clockwise direction. For convenience in turning it has finger holes eleven in number around its outer edge. Through each finger hole, except the eleventh one, a number is seen. These numbers are consecutive from 1 to 9 and back of the tenth finger hole 0 appears. In automatic practice 0 always represents 10.

There is contained within the calling device, but not seen, a revolving cam arranged to make and break the contact between a pair of springs. An escapement geared to a small governor controls the speed at which the cam revolves. The power is furnished by a clock-spring which is rewound each time the subscriber turns the dial. The cam does its work after the subscriber's finger strikes the stop and while he is placing his finger in the next hole. If he tries to turn the dial before the cam rotation is finished, he finds it locked. It stays locked until the cam rotation is completed.

Turning from the discussion of the subscriber's station to the central office equipment, the machines which make the connections between subscribers' lines are divided into the following classes:

1. Line switches. 2. Selector switches. 3. Connector switches.

A connector switch commonly called a "connector," is the last one operated in completing each connection; but as its functions correspond most closely to those of an operator on a manual switchboard it will be considered first.

There are two principal differences between the work of an operator on a multiple switchboard and that of an automatic connector. The first lies in the difference in the number of lines to which they have access. The operator has within her reach a multiple jack for every line in the switchboard, be the number of lines 1,000 or 10,000. She may, therefore, make a connection to any line entering the office, but a connector switch has access to but 100 lines. Secondly, a subscriber's operator takes the orders of and makes connections for certain predetermined subscribers only. The number she serves seldom exceeds 200 and is often less than 100, but a connector switch is, when idle, ready to handle the order of any subscriber who may wish to connect to any one of the 100 lines to which it has access.

Talking current is supplied to the transmitters of both telephones from the central office battery through the relay coils of the connector switch, just as in manual practice it is supplied through the relay coils of the cord circuit. The talking circuit includes nothing but these coils and the subscribers' stations. Its simplicity and perfect balance are shown by the circuit in Fig. 1.

One connector switch cannot, of course, handle all calls to the 100 lines to which it has access. In the average plant, 10 connectors are sufficient, however, for each 100 lines, because ordinarily not more than 10 subscribers in any hundred are ever receiving calls simultaneously. Consequently a system of 10,000 lines, for example, is divided into 100 groups of 100 lines each, the calls to the subscribers in each group being completed by a set or multiple of 10 connector switches. Where it is found necessary, more than 10 connectors may be put in a multiple; where expedient, economy is attained by putting in less than 10. Uniformity is desirable, however, and it is therefore good practice—although it is not general practice—to exercise some care in arranging the subscribers' numbers, so that

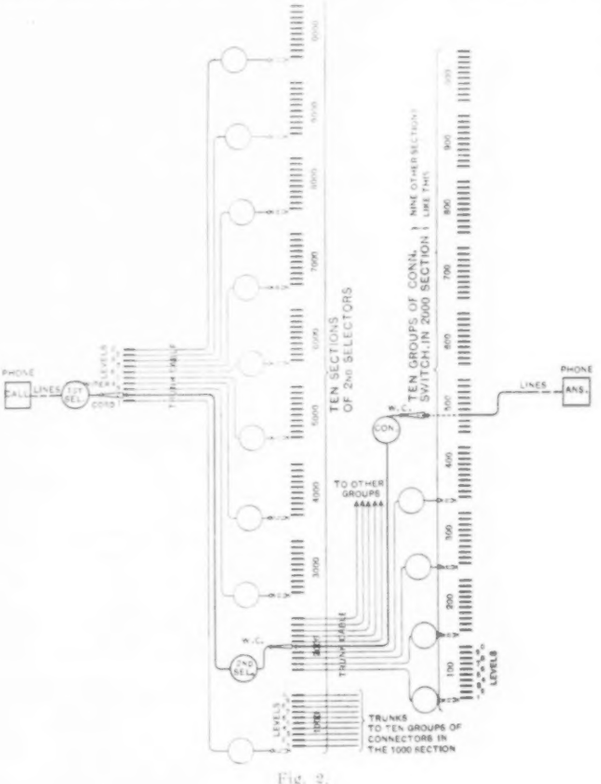


Fig. 2.

*Paper read before the American Institute Electrical Engineers, February 11, 1910.

each group of 100 will contain approximately the same proportion of frequently used lines to lines that are used less often. The grouping of lines is strictly according to number; that is, all lines numbered from 2100 to 2199 are put into one group and connected to by one set of connectors, while all lines from 2200 to 2299 are put into another group, etc. It will now be understood that a calling party, to complete a connection to a desired line, must first obtain connection to an idle connector switch belonging to the group or multiple in which the desired line terminates. In other words, processes of group selection and of idle switch selection are performed by other switches which do their work before the connector switch is operated.

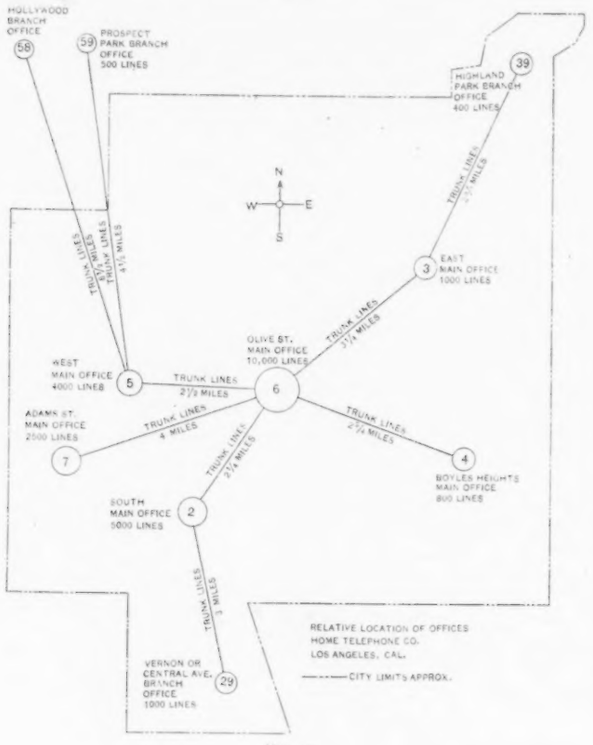


Fig. 2.

These switches, which are called selector switches, have already been mentioned. A selector switch looks, and is, very much like a connector switch; in fact the mechanism and banks are the same. The differences are in the circuits and relays only. In a system of 10,000 lines, these selectors are divided into two classes; namely, first selectors and second selectors. While there is a group of connector switches for each 100 lines to which connections are to be made, there is a group or multiple of second selectors for each 1000 lines to which connections are to be made, and a group or multiple of first selectors for each 10,000 lines to which connections are to be made. The bank contacts of the selector switches are terminals of trunk lines instead of subscribers' lines. The first or lower row of first-selector bank contacts constitutes the terminals for a group of 10 trunk lines leading to second-selector switches in the 1000 section of the plant. The second row represents another group of 10 trunk lines to second selectors in the 2000 section of the plant, the third row represents a group of trunks leading to second selectors in the 3000 section of the plant, etc., so that through the 10 rows of bank contacts the first selector has access to 10 second selectors in each of the 10 sections of 1000 lines which make up a 10,000-line office. The first selector switch used by a calling subscriber is operated in accordance with the first digit of the number he calls. Suppose, for example, he is calling the number 2543. The impulses sent in by the first movement of his calling device will raise the shaft, and accordingly the wipers of the first selector switch two steps, placing each wiper opposite the row of bank contacts second from the bottom in its respective bank. Now the selector switch unlike a connector switch, does not wait for the subscriber to make another turn of his dial before rotating its shaft, but the rotation is automatic and beyond the subscriber's control.

The rotation starts the instant the vertical movement is completed, and, in the particular case which is here used as an example, sweeps the wipers step-by-step over the row of bank contacts connected to trunks leading to the 2000 section. At each step of the rotation the bank contacts on which the wipers then rest are given the busy test, and as soon as a disengaged trunk line is found the rotary movement stops and the connection is completed to an idle second selector. This is all accomplished in a fraction of a second, so that the second selector is operated by the subscriber's calling device impulses corresponding to the second digit, 5, of the number 2543 which he is calling. The wipers of the second selector are accordingly raised five steps and are then automatically rotated just as the first selector wipers were. The bank contacts of this second selector are the terminals of the trunks to the 10 set of connectors which complete the connections to the line groups making up the 2000 section of the plant. Consequently when the second selector wipers stop on an idle trunk in the fifth multiple, the calling subscriber is placed in connection with an idle connector in the 2500 groups; that is, a connector which has access to the desired subscriber's line No. 2543. This connector is then operated by the last two movements of the subscriber's calling device, and performs the functions of an operator in the manner already described at some length.

Fig. 4.

Fig. 10.

Fig. 2 is an endeavor to illustrate this grouping arrangement and shows the connection just described from the calling telephone to a first selector, then from the second row of first-selector bank contacts to a second selector in the 2000 section of the exchange, then from the fifth level of this second selector's bank contacts to a connector switch in the 500 group of the 2000 section, and then through the fourth row of the bank contacts of this connector to the called telephone.

It is readily understood that by thus using a first selector to pick out a trunk to any one of ten different 1000 sections, second selectors in each section to pick out trunks to any 100 group in each 1000, and then by using the connectors to complete calls to individual lines in each 100, that connection may be made by the use of three switches from any calling telephone to any number from 0000 to 9999 or, in other words, to 10,000 different numbers. It will also be readily understood that by using a fourth switch, called a third-selector switch, and using numbers with five digits instead of four, that the capacity of the system will be multiplied by ten and will be 100,000 lines instead of 10,000. In a system of 100,000 lines, 10,000 numbers are generally set aside for each main central office. Consequently on each call the first selector picks a trunk to the desired office, the second selector picks a trunk to the desired 1000 in that office, the third selector picks a trunk to the desired 100 and the connector completes the connection to the desired line.

Systems of 100,000 lines' capacity have been installed in a number of different cities. One of the most notable is that in Los Angeles. This system is illustrated in Fig. 3. As shown, there are six main offices, each with an ultimate capacity of 10,000 lines.

The Olive street main office is now equipped for 10,000 lines, West for 4,000 lines, Adams for 2,500 lines, South for 5,000 lines, Boyles for 800 lines, and East for 1,000 lines. The numbers in the South office all commence with 20,000. Those in Olive street office all commence with 60,000, etc.

South office has a branch office called Vernon; West office has two branches which are called Prospect Park and Hollywood; East office has a branch called Highland Park. The numbers in each branch office commence with the same digit as the numbers in the main office to which it connects. That is; one of the sections of 1,000 numbers are taken from the main

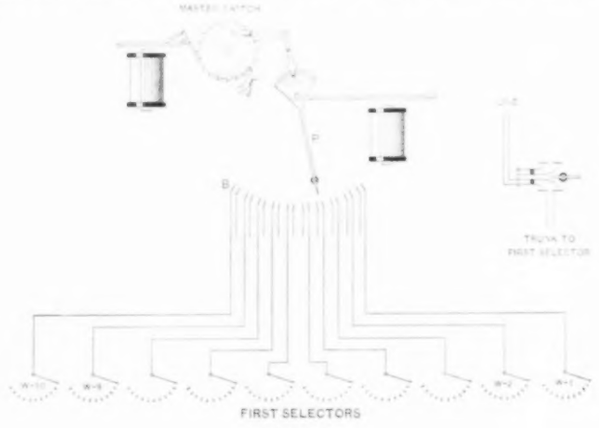


Fig. 5.

office and are set aside for use in the branch. For example, the lines now equipped in South office are numbered from 21,000 to 25,000 and the numbers in its branch Vernon, run from 29,000 to 29,999. It is, of course, unnecessary for a calling subscriber to know to which office he is connected or to which office the party he desires to call is connected.

The trunking between offices is all automatic. A subscriber, for instance, in the South office, who, on the first move of his dial turns it from the number 2, will automatically select a local trunk line to a second-selector in South office. If he makes the first turn from the number 3, a first selector at South office will automatically connect him to a trunk line terminating in a second selector at East office. Or, if he makes the first turn from the number 6, the first selector at South office will automatically select an idle trunk to Olive street office, etc.

Suppose a subscriber connected to the South office

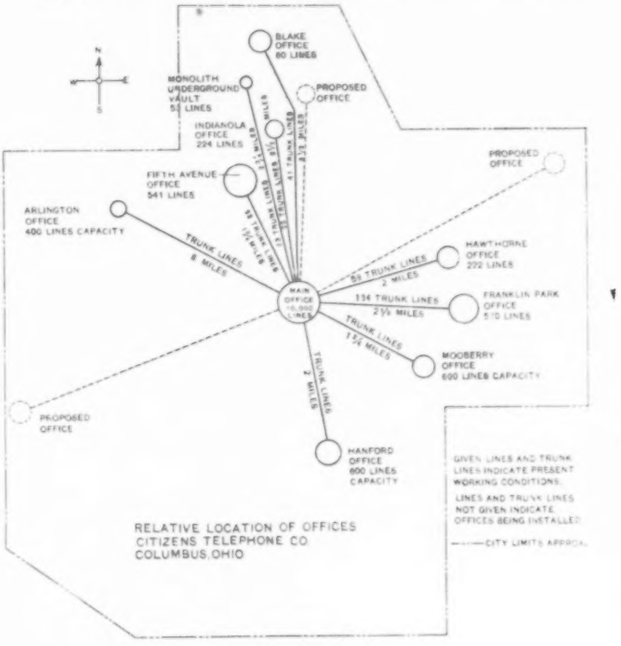

BLAKE OFFICE 60 LINES
MONOLITH UNDERGROUND VAULT 50 LINES
PROPOSED OFFICE
INDIANOLA OFFICE 224 LINES
FIFTH AVENUE OFFICE 541 LINES
PROPOSED OFFICE
ARLINGTON OFFICE 400 LINES CAPACITY
TRUNK LINES 8 MILES
HAWTHORNE OFFICE 222 LINES
50 TRUNK LINES 2 MILES
MAIN OFFICE
134 TRUNK LINES 2½ MILES
FRANKLIN PARK OFFICE 570 LINES
TRUNK LINES 1¼ MILES
MOOBERRY OFFICE 600 LINES CAPACITY
TRUNK LINES 2 MILES
PROPOSED OFFICE
HANFORD OFFICE 600 LINES CAPACITY
GIVEN LINES AND TRUNK LINES INDICATE PRESENT WORKING CONDITIONS.
LINES AND TRUNK LINES NOT GIVEN INDICATE OFFICES BEING INSTALLED.
CITY LIMITS APPROX.
RELATIVE LOCATION OF OFFICES CITIZENS TELEPHONE CO. COLUMBUS, OHIO

Fig. 6.

wishes to call 62,127, which is an Olive street office number. The first movement of the dial operates a first selector at South office, and extends the connection over an idle trunk to a second selector switch in the Olive street office. The second digit 2 will operate the second selector at Olive street office, and extend the connection to a third selector in the 2000 section of the Olive street switchboard. The third digit 1 will extend the connection to an idle connector switch in the 100 group of the 2000 section. The last two digits will operate this connector switch and complete the connection to 27 in this particular 100.

It is interesting to note that the distance from Vernon office to Highland Park office is over 12 miles, and that the distances between the other offices are quite long. It is therefore apparent that the trunks between switches may be of almost any desired length. It is also to be noted that the time required to complete a connection and the number of machines used is independent of the number of offices through which a connection may be trunked.

It should be said here that in all 100,000-line systems the numbers are made up of a letter and four figures instead of five figures. Fig. 4 shows a calling-device number disc for a system of this size. Using this arrangement 26,187, for example, would appear in the telephone directory as B-6187. When operating the calling device many subscribers will remember a letter and four figures more clearly than they will five figures.

It might be inferred from the foregoing that there is one first-selector switch permanently connected to

every subscriber's line. Formerly this was the case, but in a modern plant each line terminates in a much smaller and a cheaper device called a line switch. The line switch is not under the control of the subscriber, but connects him automatically to an idle first-selector switch the instant he removes his receiver from his switch-hook preparatory to making a call. The first-selector is, therefore, operated by the first impulses transmitted from the subscriber's calling device just as in the older systems. When the line switches are

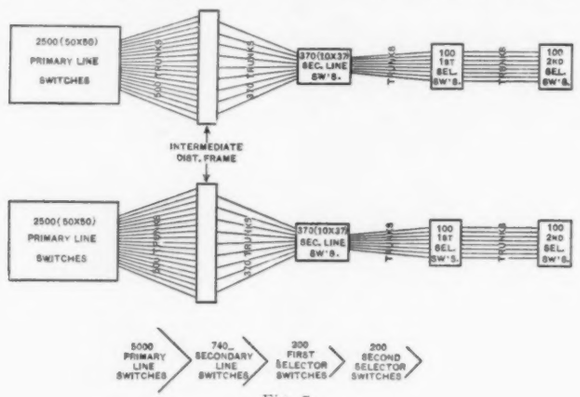

2500 (50X50) PRIMARY LINE SWITCHES
INTERMEDIATE DIST. FRAME
370 (10X37) SEC. LINE SW'S.
100 1ST SEL. SW'S.
100 2ND SEL. SW'S.
5000 PRIMARY LINE SWITCHES
740 SECONDARY LINE SWITCHES
200 FIRST SELECTOR SWITCHES
200 SECOND SELECTOR SWITCHES

Fig. 7.

used, 10 first-selectors for each 100 lines are generally sufficient to handle the traffic.

Each line switch includes the line and cut-off relays with which each line is equipped just as in manual practice. It also includes a movable plunger arm at the end of which a plunger is so pivoted that it may be swung back and forth over the line-switch bank. The bank consists of 10 sets of springs and represents a multiple of 10 trunks to first-selector switches. The line switches are mounted in groups of 25 each on the face of an upright in such a manner that the plungers are in alignment.

When a subscriber removes his receiver from his telephone switch-hook preparatory to making a call, a circuit is thereby closed which causes the plunger arm of his line switch to be instantly pulled down, carrying its plunger out of engagement with the master-shaft

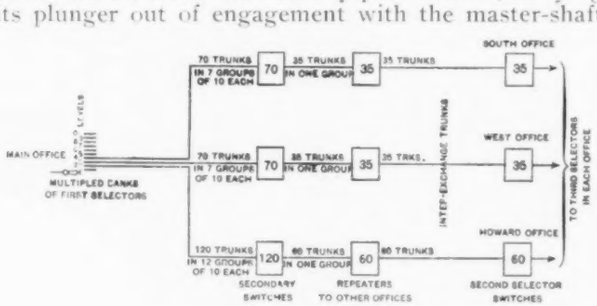


Fig 8.

and thrusting it into the bank. The effect of this is to connect the subscriber's line to a trunk leading to an idle first-selector switch, as shown diagrammatically in the right-hand portion of Fig. 5.

The instant that one line switch thrusts its plunger into the bank, thus occupying the trunk over whose multiple all idle plungers have been poised, the master-switch operates and swings the remaining idle plungers forward over the next multiple of bank contacts. If this trunk should be busy, the movement proceeds until an idle trunk is found. It is to be noted that a line switch always uses a pre-selected idle trunk instead of making a selection after a subscriber starts to call as the Strowger selector switches do. This is quite an important feature and saves considerable time in establishing a connection.

Ordinarily the banks of 100 line switches are multipled together and connected to 10 first-selector trunks, but for four-party line service or extra heavy traffic, the number in one multiple is often reduced to fifty. While the primary object of the line switches was to reduce the cost of the switchboard by eliminating 90 per cent of the comparatively expensive first-selector switches, they have also simplified the central office equipment and have reduced the space required for it. Further, they have resulted in several new and somewhat radical departures in the art of building automatic telephone systems. The most important of these is the line-switch district station which enables very considerable savings to be made in underground and aerial cable.

A district station is installed by placing one or more line-switch units complete with connector switches in a small building at the telephonic center of a district, generally a mile or more distant from the nearest central office. The lines of all telephones in the district are brought to the district station and are there connected to the line switches. The first selectors to which these line switches are trunked remain at the nearest large central office, consequently when a district station subscriber removes his receiver from his switch-hook preparatory to making a call, his line switch instantly puts him into connection by means of

Fig. 9.

a trunk with a first-selector switch at central office. The connector switches for handling the calls to the district station telephones are mounted in their usual places on the back of the line-switch units, and are connected by trunks to the banks of second selectors, also located at the nearest central office. Thus all calls from and to the district are handled over trunks instead of over subscribers' lines.

Since, as already stated, there are usually but 10 first selectors and 10 connectors for each 100 lines, and since but three pairs are needed for testing and supervisory circuits to the district station, a total of 23 trunk pairs is sufficient between the station and the central office. This leaves a net saving of 77 pairs of wires per 100 lines. In district-station practice stations of less than 500 subscribers are generally unattended and supervised entirely from the central office to which they connect. This is so thoroughly worked out that the wire-chief can test every line entering each district station without leaving his desk at central. Stations of 500 lines or more are generally put into a combination residence and office building so that one attendant living in the building gives the equipment all the attention that it may require at any time.

Fig. 6 is a sketch of the notable system in Columbus, Ohio, using one large central office of approximately 10,000 lines, surrounded by 9 district stations, varying in size from 100 to 600 lines. One of these

100-line units in Columbus was installed as an experiment in an underground vault about the size of an ordinary underground manhole, and has now been so operating for about two years.

One can readily imagine that the trunking scheme of this system would be very complicated if each of the small offices shown in the illustration had trunks to each of the other offices. Furthermore the cost of trunks divided into such small groups would be so much greater, that the saving in line wires would be much reduced and in some instances almost wiped out. But using the district stations each having trunks to no office except the central office (placed near the business center of the city) the trunking plan is a very simple and economical one, and the conditions for centralized supervision of the system are practically ideal.

A new feature called a secondary line-switch has very recently been introduced into the automatic system. The mechanical construction of this switch and of its bank is the same as that of the regular or primary line-switch, and it is mounted and controlled by a master-switch in the same manner. The purpose of the switch is still further to reduce the required number of first-selector switches, and their trunks. As explained, it has been the general practice to install a number of first selectors equal to 10 per cent of the number of subscribers' lines. Observations made in numerous plants at the busiest hour of the day, however, show that at the peak of the load not more than from 1.5 to 5 per cent of the subscribers are using first selectors. The percentage is smaller in the larger plants and greater in the smaller plants, being about 5 per cent for a plant of 1000 lines and not over 2 per cent for a plant of 10,000 lines. This reduction in the percentage of trunks required as the number of subscribers' lines increases, follows a law well known among telephone engineers. The secondary line-switch takes advantage of this principle by making it practicable to give 2000 or 2500 subscribers' lines access to one group of 100 first selectors. The secondary switches are inserted between the line-switches and the first selectors in such a way that the primary line-switches pre-select idle secondaries and the secondaries pre-select idle first selectors. Therefore, when a subscriber lifts his receiver from the switch-hook preparatory to making a call, his line-switch and the secondary to which it connects him operate almost in unison. This pre-selection of trunks, combined with a rather complex system of cross-multipleing, accomplishes the desired result of giving a large number of subscribers access to one group of trunks, and thereby reduces the number of trunks and first selectors. It is obvious that if the first selectors are at a considerable distance from the line-switches, for example, in a central office while the primary and secondary line-switches are in a district station, that these secondary switches will save materially in the cost of trunks to the first selectors.

Fig. 7 shows the use of secondary line-switches in the general trunking equipment scheme for one of the automatic offices now being installed in Havana, Cuba. This office is equipped for 5000 lines. The line-switches are divided into two large groups each of 2500 lines, and each consisting of 50 small groups or multiples of 50 lines each. The trunks from a 2500-line group pass through an intermediate distributing frame to 370 secondary line-switches, arranged in 10 sets of 37 each. Each of the 10 sets has trunks to 10 first-selector switches. Thus, all calls from 2500 lines will be handled by 100 first selectors.

An automatic system equipped for 15,000 lines divided among four offices, was installed in San Francisco last year. Secondary line-switches are there used between the line-switches and the first selectors and are also used to reduce the trunks between offices. In former practice each inter-office trunk terminated in first-selector banks at the calling office, and in a second-selector switch at the called office, but in San Francisco each trunk between offices terminates in secondary line-switch banks at the calling office. Then, short local trunks connect the secondary line-switches to the first-selector banks. Fig. 8 illustrates the trunks outgoing from Main office to Howard, West and South offices, indicating that the secondary line-switches reduce the trunks to Howard office from 120 to 60, the trunks to West office from 70 to 35, and the trunks to South office from 70 to 35, by combining the trunks coming from the first-selector banks in groups of 10 each, into one group to each office.

Inter-office trunks in automatic systems are equipped with another piece of apparatus which is also indicated in this sketch and which is called a repeater. This is simply a set of relays, and derives its name from the fact that it repeats the calling-device impulses from the subscriber's line to the trunk. It serves another important purpose, for through its relay coils, talking current is supplied to the transmitter of the calling subscriber.

Talking current is always supplied to the called subscriber's telephone through the connector switch used in calling him. Such an inter-office talking circuit is shown diagrammatically in Fig. 9. Each subscriber always receives talking current from the office in which his line terminates. This is in conformity with the best practice which requires that the subscriber's "loops" shall be as short as possible, and as nearly alike in resistance as conditions will allow. This makes it practicable to supply all transmitters with sufficient current through small and economical line wires, and to supply them all with comparatively the same amount of current.

Fig. 10 shows a calling-device number disc such as used in the Chinese quarter of San Francisco. This disc is equipped with Chinese characters, and up to this time the section of the automatic switchboard which serves "Chinatown" is one of the busiest in the exchange.

A. I. E. E. Paper on Measuring Instruments

The Pittsburg section of the American Institute of Electrical Engineers held its regular meeting on January 11, 1910, in the Carnegie lecture room.

Mr. Harold W. Brown, for several years in charge of the meter department of the Westinghouse Electric and Manufacturing Company, presented an original paper on "Recent Designs in Electrical Measuring Instruments." Mr. Brown showed lantern slides illustrating the most recent designs of both European and American indicating, integrating, and recording meters, including instruments using electricity for measuring other quantities.

The practical advantages to the operator effected by the revised designs was clearly pointed out and the discussion which followed was one of the best during the year.

Some Economic Problems of Telephones

By J. P. Boylan*

THE value of a trained operator, from the standpoint of giving efficient service, is conceded by the telephone manager and indorsed by the telephone using public. The matter of a systematic training for the operator, however, is a condition which for some reason or another has been sidetracked and avoided most persistently. There seems to be no good reason why this state of affairs should exist except for the mistaken idea which seems to prevail that the cost of training an operator would be excessive. A natural consequence is, therefore, the employment of the so-called experienced operator.

The idea that the proper training of an operator is expensive had its inception when it was compared with the training of employees in other departments, which training is productive of good return to the company, considering the small apprenticeship wages paid. The prospective lineman serves his time as lineman's helper or groundman. The prospective wireman or installer is employed as installer's helper. The switchboard troubleman of the future receives his experience as switchboard installer's helper, or a wireman is advanced to the wire chief's desk and to switchboard troubleman. With the operator, however, the time served as apprentice is considered a total loss and so treated until such time as she is proficient enough to handle calls unassisted. Such a conclusion is a grave mistake, and I will try to show that there is not only a distinct advantage in the systematic training of your own operators, as regards the efficiency of service rendered, as well as from a strictly economic standpoint.

If experienced operators are scarce (and I might add that nothing is more scarce than an experienced operator out of a position), green girls are employed. As a usual thing the green girl, or student operator, is given a receiver and head band and is placed alongside of one of the old hands, with instructions to "look and listen." She watches the flash of the line signal, hears the subscriber's voice and marvels at the rapid movements of the operator amid the maze of tangled cords and flying plugs. At the very outset she is confused and discouraged. She considers it well nigh impossible for her ever to emulate the acuteness of mind or the dexterity in manipulation of the model before her. Consequently, after the lunch hour is over the green girl is often among the missing. She has been scared away, and it is to be little wondered at. What would be your opinion of the management of a grammar school where the little beginners, instead of being introduced gradually to their a b c's, were taken up to the eighth grade, and told to look and listen, while an examination in algebra was taking place?

Not all of the student operators become discouraged, and after several days of watching and listening they are permitted to answer a call. Here is where the phrase "long suffering public" could be aptly applied, for, from this period, the operator becomes experienced at the expense of the subscribers.

I am not referring altogether to the smaller companies in this matter. A few weeks ago while calling over a telephone in a city of over 400,000 population, I was answered by a student operator, who, judging from the sound of her voice, was badly frightened. She repeated my number incorrectly and I could plainly hear another operator prompting her. The delay occasioned was such as to warrant the regular operator stepping in and completing the call. In these days of progressive business management, what is the subscriber to think of a telephone company which permits such a state of affairs to exist? There is absolutely no excuse for such a condition. It is unfair to the student, unfair to the telephone management, and unfair to the public. The wide awake telephone manager ought not to permit a student to come into contact with a subscriber until she is capable of properly executing a call.

Neither of the methods used, namely, the education of green operators as outlined, or the employment of so-called "experienced operators," is the correct solution of this problem. In the latter instance some very pertinent questions could be proposed, as:

1. How does it happen that the experienced operator is out of a position?
2. Is not the type of your board different from the one the operator worked on, and will it not take time for her to get accustomed to yours?
3. Are not phrases used different from the ones employed by her in the other company?
4. Is there not a considerable difference between the operating rules of your company and those of her former company?
5. On the strength of being an experienced operator, is not the maximum salary demanded?
6. Is it not more simple to teach a student the correct method as you see it than to change the ideas of this experienced operator and to bring her to your way of thinking?
7. In view of the above, is not the term "experienced operator" questionable, to say the least? Considering everything, would not a green girl systematically trained be more desirable?

The Louisville Home Telephone Company has an effective and inexpensive school for students. The two end positions are utilized for this purpose. The operator listening key, ringing key, the answering jacks, and lamps, the multiple, etc., are each numbered with a small paper sticker, and the two students are given a typewritten paper similarly numbered, setting forth the names of the different pieces of apparatus. A study of this paper comprises the first lesson. Two desk telephones are mounted at these positions, both connecting with answering jacks and several dead numbers in the multiple, and the completion of a call. For practice, one student will take down the receiver of one of the desk sets and the other student will answer the call. The student at the desk set will call for one of the numbers given in the lesson. In similar manner numbers are called, one to the other, from the directory, wooden plugs being used for practising in finding numbers only. At the end of each half-day the chief operator or supervisor reviews the work of the students, so that at the end of twelve lessons, or a week's time, the

*Paper read at independent convention.

students have practically trained themselves. Some of the larger cities have operators' schools on a more elaborate scale while others have no school at all.

The most complete independent operating school in the country is conducted by the Home Telephone Company, of Michigan, at Detroit. With the single exception the chief operators, the present large force of operating employes, including supervisors, information clerks and operators, are the product of the school. As a direct result of the school, the service given the subscribers is equal, if not superior, to that given anywhere else, while, on the other hand, the average operator's rate is, comparatively speaking, the lowest in the country.

The question of operators in Detroit resolved itself into one of two things. Either that of employing experienced operators, or installing a school for inexperienced operators. The latter plan was decided upon for the following reasons:

1. The efficiency of a student after leaving the school will be almost equal to that of the so-called experienced operator, because the phrases and mode of operation will be new to the experienced operator, and it was believed that students would work up speed in operating nearly equal to that of the others.

2. Experienced operators out of employment, as well as those seeking a change, are, as a general rule, undesirable.

3. The other company, on losing a number of operators, would undoubtedly arouse public sympathy their favor.

4. Student operators would be paid $20 per month for several months after they entered the employ of the company, while experienced operators could not be had for less than $25 or $27, and in some cases $30.

It was calculated at the outset to open the city exchange with a force of about forty operators. You will observe that the feature of economy looms up very strongly when one considers that the number of experienced operators at even as low an average as $25 would cost $1,000 per month, as against $800 for the same number of school graduates at $20 per month. Even considering this saving in operators' salaries, it was calculated sufficient to pay for the student switchboard and all accessories in less than a year's time.

Three and a half months after the cut-over, there were forty-two operators and sixteen others on the pay roll, varying from the chief operator to the messenger. The average operators' rate was $20, and the total average, including every employe of the operating department, was $21.77. The entire cost of the twelve position student board, including four teachers' desks, amounted to something like $3,800. The reason for this figure being so low was that only the necessary apparatus required for students' practice was installed and the balance was made up to represent, in appearance only, the regular switchboard.

While the complete multiple of 8,000 lines appears in each of the four sections, only 1 per cent is represented in real multiple jacks, the strips of which are scattered throughout the multiple. The balance is of the dummy type, but the imitation is so cleverly executed that few students have been able to tell the difference between the real and dummy jack until they have about completed their student period.

The students' switchboard is divided into four parts. Each part, or section, comprises three positions, the circuits of which are connected to a teacher's desk, the idea being to have one teacher in charge of three students. The course of instruction is divided into twelve lessons, each lesson occupying a half-day. Twelve students per week can be turned out of the school, and if necessary this number can be increased to twenty-four a week by conducting an evening class.

The Detroit student's manual deviates somewhat from that employed in other operating schools, in that charts are not used, because as a rule, they are not understood by the average student. Neither are preliminary lectures given, because such talks necessarily have to do with the apparatus and modes of handling the same, with all of which, at this time, the student is unfamiliar. It, therefore, follows that a lecture would not be comprehensive and at the best would only tend to confuse the student.

Before taking up the first lesson, each student must undergo a test in sight and hearing. This is a very simple affair, the student being simply required, in the test in sight, to read certain numbers on monitor plugs, also on several multiple jack numbers. For the test in hearing, the teacher equips the students with a regular operator's set and reads fifty numbers from the directory, requiring the student to repeat each number.

The students are then seated at the school board and given their first lesson, which is furnished them in printed form, and comprises rules governing the students' conduct while on duty and in the building. This lesson also includes a simple explanation of the switchboard. The organization of the operating room, including the various persons in authority in the operating department, is also explained.

The second lesson deals entirely with the multiple and after it has been thoroughly explained to the students, the teachers call off various numbers in order that students may practice until they are able to find any number quickly.

In the third and fourth lessons, other features are introduced, and so on up to the twelfth lesson. The student is instructed in something new daily, and in this manner has no trouble in absorbing and retaining what she has learned. Actual practice in handling calls occupies much of the time after the fourth lesson. The last half hour of each lesson is given over to a review of all previous lessons, including practise.

The teacher in giving the student a call inserts a plug in the jack at her desk, which lights an answering lamp at a student's position. The student answers the call in the regular manner and the teacher, taking the place of a subscriber, calls for a number which is represented in the multiple by a real jack. As soon as the student inserts her calling plug in the jack, it will light a lamp corresponding to the multiple jack on the teacher's desk. The teacher, by inserting a plug in the jack under this lamp, can put out the supervisory lamp on the student's calling cord, indicating to student that the caller subscriber has answered.

The teacher, by means of her cords, has entire control of the supervisory lamps and can flash either lamp at will. By taking down the pair of cords at the teacher's desk, both supervisory lamps on cords at

the student board will light, giving the student a disconnect signal.

When the teacher calls for a number in a branch exchange, the student, after answering the call in the regular manner, will switch in on the branch exchange order wire, which is connected to the teacher's telephone, the teacher in this case taking the place of the "B," or trunk operator, at the branch exchange, and assigning the trunk number for the student. When the calling cord is inserted in the trunk line at school, a lamp is lighted on the teacher's desk in the manner previously described. The teacher can either put the busy back signal on this trunk, when the student should report to subscriber, or teacher, that the line is busy, or the teacher can put out the supervisory lamp on the calling cord, indicating to the student that the branch exchange subscriber has answered.

The teacher can put a busy test, or out of order tone, on any line on the students' board and call for this line, in order to test the student on these particular features. In similar manner, every conceivable circumstance or combination which might arise between a subscriber and the operator is thoroughly and effectively explained, so that when the student takes her position on the regular switchboard, she is never at a loss to know what to do in any emergency.

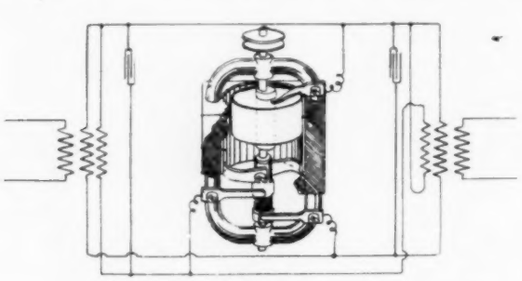
Recent Telephone Patents

By David S. Hulfish

942,248. Fuse. The object is to provide means for visual indication when the fuse is blown. The means is a plunger spring-pressed and placing a tension upon the fuse wire. When the fuse wire is destroyed by its operation as designed, the plunger is released and is forced by the spring into a prominent position. In this way a glance at a bank of fuses reveals which of them have been blown. Frank B. Cook, Chicago, Ill.

942,332. Electrical Conductor. The conductor is designed for composite service, is discontinuous conductively for the telephone circuit and continuous conductively for such other circuits as may be desired, the telephone working through a capacity between the two conductors. Isidor Kitsee, Philadelphia, Pa.

942,885. Telephone Repeater. The repeating device is power-driven, taking energy from a belt and presumably utilizing a portion of the belt energy in reinforcing received currents before transmitting them to the continuing portion of the line. The mechanical device comprises plates forming a series of condensers, means for connecting the condensers in turn in the incoming circuit, means for separating the plates of the condensers in turn, and means for connecting the condensers in turn in the outgoing circuit. Percy A. Campbell, Bloomfield, N. J.



942,885.

943,033. Attachment. The device is adapted to support the telephone receiver in position for use. A band clamp surrounds the transmitter chamber, a similar clamp surrounds the receiver, and the two are united by an arm having a hinge. William J. Mogridge, Spokane, Wash.

943,081. Peg Count System. A contact plate is located near the switching plugs and the operator records each time the plug is lifted by touching the contact plate with the tip of the plug. Willard J. Kibbe, Canandaigua, N. Y.

943,115. Selective Signaling Apparatus. The system consists of a four-party line having four signalling bells each associated with a retardation coil and connected according to a system already known in connection with this inventor's design, the two units at each station being in series at one station and in multiple at another. Oscar M. Leich, Rochester, N. Y., now of Genoa, Ill., assignor of parts to J. G. Ihmsen and Max W. Zabel, both of Chicago, Ill.

943,149. Transmitter Mouthpiece. The mouthpiece consists of an open funnel having a side aperture between its open front and back ends, the side aperture connecting with a chamber extending to the transmitter diaphragm. The object is the provision of a sanitary device, and of a device which will avoid the muffling effect of a tube closed at one end. John A. Jamieson, Harrison, N. J.

943,305. Illuminated Dial. The object of the invention is to provide illumination for the dials of automatic telephone calling devices and the circuits of the device are such that current for the illuminating lamp is taken from the telephone line. Rufus B. Hallock, Portland, Ore.

943,386. Sanitary Attachment. A mouthpiece or a mouthpiece container is provided with a cover whereby it may be closed when not in use. In one of the designs shown the cover is pivoted and is associated by a link with the telephone hook lever in such manner that when the receiver is moved from the hook the mouthpiece will be uncovered. Marvin Y. Calcutt, Seattle, Wash.

943,915. Transmitter. This patent has for its subject matter a telephone transmitter designed for loud speaking effects. The device was exhibited at the recent telephone convention. It consists of multiple resistances connected in such manner that the action of some will reinforce the action of others. J. J. Comer, Baltimore, Md., assignor to George R. Webb of same place.

944,120. Telephone System. The invention is an improvement in methods and means for answering the calls coming in upon a manual switchboard. In other systems there have been embodied devices such as relays, by which a subscriber is connected directly to the operator's telephone circuit as soon as he removes his telephone from the hook. In the present invention the number of devices for effecting this automatic connection is much reduced. Instead of a relay per line Mr. Wynne uses a relay placed in a pilot circuit or equivalent circuit of the operator's position in such a manner that the one relay effects the result desired. William A. Wynne, Raleigh, N. C.

944,227. Telephone System. The object is to avoid the use of a manual listening key in the cord pair, and the function of this key is taken by relay. William A. Wynne, Raleigh, N. C.

944,066. Attachment. The object is the disinfection of the transmitter mouthpiece and the means is an atomizer suspended upon the telephone and adapted to spray a disinfectant into the mouthpiece. Russell B. Adams and Llewellyn Adams, of Westerville, Ohio.

944,412. Telephone Box. The invention relates to the arrangement of the wood component parts of a wall set case and the means for attaching them together. It affords a receptacle for the necessary parts and offers easy access to the different parts. William M. Bruce, Jr., Springfield, Ohio, assignor to American Automatic Telephone Company, Urbana, O.

944,460. Selecting Apparatus. The invention provides a new and novel design of ratcheting device for step by step multiparty lines. Charles E. Nicholas, Columbus, Ohio, assignor to Nicholas Telephone Selector Company, Rochester, N. Y.

New Police Telephone and Signal System

By D. H. Braymer

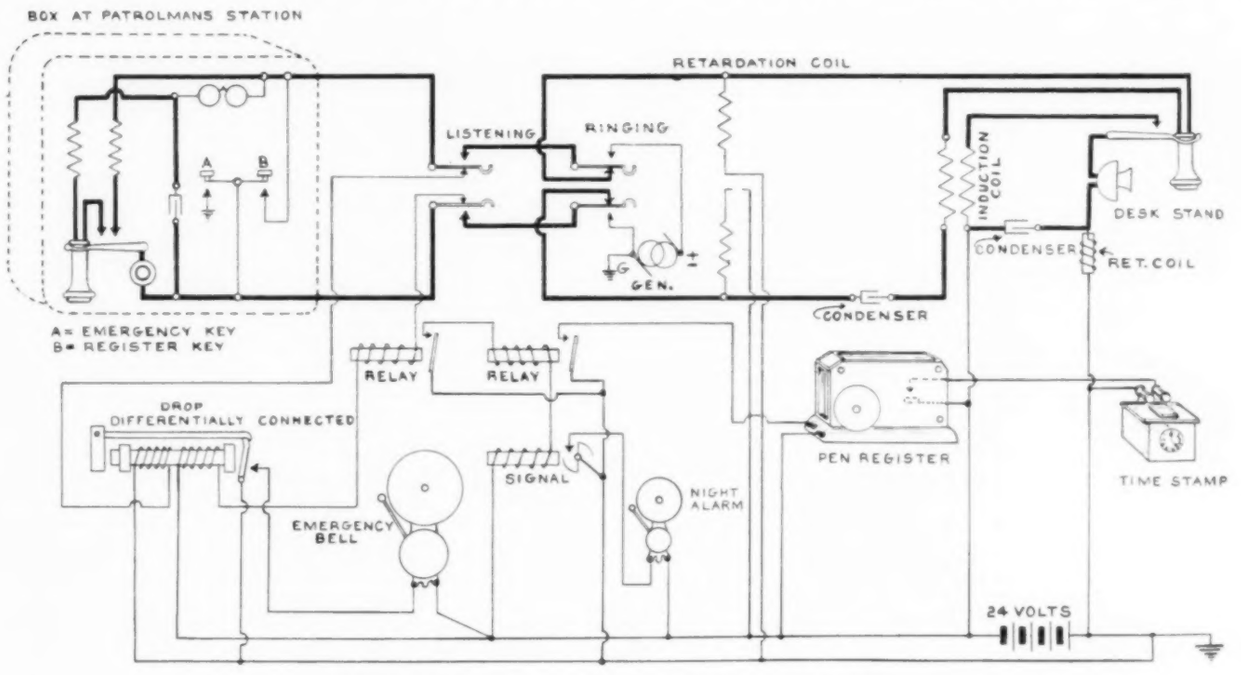
IN view of the fact that the executive staff of the police department in our small cities is generally limited and the efficiency of the police patrol system rather low, a combined police telephone and signal system has been devised and successfully installed at Sioux Falls, South Dakota. This system is used as an aid in directing the movements of the police force in cases of emergency, and also provides a means whereby the chief of police may obtain a record of the movements of his men on the different beats, even if it is necessary for him to leave his desk for some time. The system enables him to get in touch with patrolmen in any section of the city in an emergency, and, further, makes it possible for the patrolmen to send special information to headquarters and to record it there, even if the chief is not at his desk.

In large cities where a desk man is always on duty, this special recording apparatus is not so necessary. In New York City, for instance, a police telephone system has been installed with weather-proof iron box telephone sets located at short intervals around the city, and private exchange switchboards placed in the precinct headquarters. The patrolman reports to the desk sergeant from the telephone box on his beat, and then receives any special directions which the chief wishes to give.

In the Sioux Falls installation, the telephone feature has been retained, but special signaling and recording features have been added. The weather-proof telephone sets located about the city are provided with two ordinary telegraph keys shown at *A* and *B* in the diagram. This iron set is about 12 inches high by 12 inches wide by 6½ inches deep, and is provided with a flanged weather-proof door equipment with a strong spring lock, a key to which is carried by each patrolman. All the telephone parts are mounted on an iron frame, which can be removed entirely from the outer box, thus facilitating inspection and replacements.

The apparatus at headquarters includes in addition to the regular telephone switchboard, a pen register, a time stamp and an emergency bell. These are employed in connection with the special signaling and recording features.

When a patrolman reports to headquarters in the course of his regular routine, he opens the door of his telephone set and presses the key shown at *B* a number of times corresponding to his individual number. Each time the key is depressed, an impulse is sent to the equipment at headquarters, and a signal is made to appear in the front of the switchboard, at the chief's desk. At the same moment, a pen register is operated and a record is made on the tape. When the patrolman sends a series of impulses by pressing the key several times in succession, the signal in the switchboard appears each time the key is depressed, and the record of his call is made on the tape. When the record is finished, a time stamp automatically operates and stamps the time of the call on the tape. If the chief is at his desk and wishes to give some directions to the patrolman, he plugs in to the jack corresponding to the telephone set from which the patrolman is



Police Telephone and Signal Circuit, Sioux Falls, South Dakota.

signaling and rings the bell in the telephone set. The patrolman removes the receiver, and is then in direct telephone connection with the chief.

Various methods of reporting can be used to suit the condition of the police departments of different cities, and the combined system as described lends itself to a wide range of users as appears best suited to the individual requirements of the police organization.

It frequently happens that the patrolman finds it necessary to get into immediate communication with the chief, as for instance in the case of a fire or other emergency. For this purpose the key shown at *A* has been provided. When this key is depressed, it causes a drop shutter to fall at the switchboard on the chief's desk, which in turn starts the ringing of a large emergency bell. This bell will ring continuously until the chief answers and restores the signal. If the chief is not at his desk, the patrolman then sends in a message, by means of key *B*, which is automatically recorded on the tape. This message is a series of long and short dashes, in accordance with a pre-arranged code to indicate a fire or needed assistance. To this record the patrolman adds his individual number, and the whole is automatically stamped by the time clock with the time of the call. When the chief reaches his desk, he can tell immediately from what box an emergency call has come, and can then tell from the tape the nature of the call and the time.

This system seems to satisfy the general demand for a combination telephone and signaling outfit, which is simple and reliable in operation, and comparatively cheap. It provides for sending individual signals when several men report to the same telephone, and makes it possible for the patrolman to send in emergency calls. It also enables the chief to regulate the movements of the men, if necessary to depart from the regular routine. Since the signal boxes at which the patrolmen report are accessible only to those having keys, there is no danger that the signals will be tampered with, and the chief is always assured of an authorative record.

As indicated above, each patrolman is given a different number, which can be recorded in dots and dashes. This makes it possible for the chief to sit at his desk and watch the signals come in, indicating whether the patrolmen are following the regular order or their beats, or he can leave the office and watch the men, or investigate some special case and be assured that when he returns to the office he will find a complete record of the movement of his force during the meantime. This leaves the chief free to attend to other duties, such as the prosecution of cases in court, investigation of complaints and burglaries, and the execution of any other important duties which make for law and order.

Hibbard on Telephone Traffic and Problems

At the meeting of the Chicago Electric Club, February 9, Angus S. Hibbard, vice-president and general manager of the Chicago Telephone Company, gave a very interesting address on the subject of Telephone Traffic and Problems. He sketched briefly the development of the telephone system in Chicago during the past seventeen years and paid tribute to the present working force of the company, which now numbers 8,100 employees.

The development of the telephone is well shown in the fact that in 1893 the Chicago exchange had but 8,200 telephones, while at present there are in the city limits about 210,000 instruments. The speaker referred interestingly to the technical meetings which are held by the employees of the company, illustrating the interest which they take in the work. Mr. Hibbard stated that in 1895 the average cost of telephone service in Chicago was $126.19 per year. Last year the average was $39.42. In other words, while everything else has increased in cost, the telephone has decreased about two-thirds. Estimating that the gain in Chicago will continue to be 30,000 subscribers per year, at end of ten years Chicago should have 450,000 telephones, which would mean that the Chicago Telephone Company would operate about 600,000 stations in its entire territory. In gaining this 30,000 telephones per year the company installs about 60,000; for one telephone is taken out to every two put in. The company has over 600,000 miles of wire buried under 614 miles of street. The development of the nickel prepayment service is due to the fact that this service is very popular; in fact, more than one-half of all of the telephones in Chicago are of that type. The maintenance of these instruments involves considerable outlay but the service is very satisfactory. Mr. Hibbard dwelt at some length on the development study work done by the company. This development study is particularly interesting and necessary in a city like Chicago, for when a new district is opened sufficient underground conduit must be installed to provide for all possible needs of the future. If this were not done it would be necessary to tear up the streets every few years to increase cable capacity. The experts who are employed in this work must be able to predict not only the growth of the city, but the growth in particular localities with great accuracy; and although the speaker stated that the company has very rarely overguessed in this direction, he would not state what the experts' estimate was for Chicago twenty years from now, as he said his audience would ridicule the prediction.

In the discussion which followed Mr. Hibbard's talk the question arose as to what effect it would have on the expansion of the telephone business if the subscriber had to pay for his apparatus as he does for his electric light wiring and installation. He stated that the investment for an individual telephone customer is between $18 and $100, although there is considerable inequality in the work of installation. For this reason it usually costs more for a company to install a telephone than the company derives from it for perhaps two years.

Telephone Improvements on Panama

The Empire Telephone Exchange, Isthmus of Panama, will shortly be consolidated with the exchange at Culebra, and the latter point will then be the telephone center of the canal zone. The Culebra switchboard will be increased to four sections, accommodating 1,300 subscribers. Common battery instruments will take the place of the old magneto telephones, and all iron wires will be replaced by copper.

With its issue for January 1, the *Telegraph Age*, published by J. B. Taltavall, became the *Telegraph and Telephone Age*, and was increased in size.

Equitable Rate Making for Public Service

By Dugald C. Jackson*

THE problems of appropriately fixing rates to be charged by so-called public service companies for the service which they render have been given much quiet study in this country for a number of years. The officials of many companies have given them extended study. The Interstate Commerce Commission has been at it, and some state commissions have also been at it. But there has as yet been little advance made in the methods of treating the difficult problems.

That plungers, corruptionists, or adventurers have had to do with the formation of some of the corporations now enjoying special franchises from the public is not a matter for surprise. Nearly all new businesses which promise to grow to great magnitude become the goal of adventurers. It is only after a business has settled into a stable and permanent state, lacking the speculative element, that it becomes generally attractive to men of established business probity, and surely free from the presence or the attacks of speculative adventurers; and the businesses engaged in by most of our public service companies are so new that the price marks still show and the paint is not yet worn. Even the railroads—strong, stable, necessary to the welfare of the country and its civilization as they are—are mere youths. The Rainhill contest, in which George Stephenson publicly proved the pre-eminence of the steam locomotive over horse flesh or cables for traction, occurred less than eighty years ago, and the railroads of the world are the offspring of that demonstration. The supply of gas for illumination is somewhat older; but the electro-magnetic telegraph as a realized embodiment is only sixty-four years old, and the grandfathers of most of this audience knew naught of such modes of communication. The speaking telephone has extended only through the life of a generation, and it is no more than twenty-five years old as a force in the service of the public. The arc light of the public streets has seen but thirty years of commercial service, and the incandescent electric light has seen even less years in the service of the public. The commercial electric street railway sprang into life less than two decades ago with the success of the Richmond experiment.

Two bed-rock principles which fit the conditions under which public service corporations do their business are these:

1. The company is granted certain privileges by the public for the purpose of enabling it to furnish readily some type of service to the people, and it should be expected to furnish service fitting the needs of the people; good of its kind, and at prices which are reasonable when judged by the conditions.

2. The company must not be unnecessarily harassed, but must be afforded every reasonable opportunity for economically transacting the business rightfully related to giving the service for which the company was organized; and it must be allowed to make such clear profits over all legitimate costs of its service that it may attract the best and fairest minds to the management, and maintain a position of stable credit with the investing public.

*Courtesy of the Massachusetts Institute of Technology.

One of the first difficulties that we meet relates to capital account. To the man who has not been in executive relations with manufacturing or operating companies, and has not been connected with industrial affairs, it is natural to assume that the capital invested in a public service plant has been all expended for the labor and material composing the physical property which any one can visually inspect and appraise. Such a man is likely to assume, as a matter of course, that every dollar in the par value of capital stock or bonds which is not represented by such labor and material composing the physical property is superfluous, and therefore of the character usually denominated "water." It is a real shock to such a man, however right-minded he may be, to learn that this view is wrong, and that many expenditures which are outside of "labor and material" are legitimately necessary for the production of an operating plant, and are legitimate charges to capital account.

The origination of a project, preliminary surveys and construction plans, and supervising the construction, all cost large sums of money in an important project, and this money is wisely expended because well-matured plans based on full information (though of large expense) conduce to greater assurance of the project ultimately rendering good service at reasonable cost. In other words, it is better to make these expenditures out of capital, rather than risk a poorly planned execution of the project; for experience proves that the latter is likely to cause more cost in the end, and consequently require of the public the payment of higher prices for service.

Expenditures must also be made for fire, fidelity and casualty insurance during the time the construction of the plant is under way, to protect the company from the chance of being wiped out by the disaster of fire or the damage costs due to some unhappy accident. Costly accidents during constructon seldom occur in well-managed work, fortunately, but casualty insurance is a wise precaution to take.

The cost of organizing the company, the legitimate lawyers' charges due to the work of organizing the project, drawing and scrutinizing papers, and the like, and the expense due to bringing the working force up to an efficiency by which the public may be adequately served, all fall within the category of expenditures which belong to the capital account.

Working capital (which is often a large cash sum legitimately required for the maintenance of the business of a company like an electric light or gas company, which sells product by meter and receives its payments from customers only after service has been rendered during a month or a quarter) is properly a part of capital account; and also the cost of taxes paid during construction, the cost for interest during the construction period and while the business is being got under way, and the cost of selling securities issued, or any discounts made for bringing about the sale, belong to capital account.

The item of interest during construction is one which is often disputed, but I think only through misapprehension. The well-established public service corporation which is doing its duty, ordinarily should make its charges for service so reasonable that it can pay the investors

a return on their invested money which is only enough higher than the ruling rates of interest to make the securities marketable in the face of the precarious, shifting character of a new branch of business which is subject to all of the changes caused by astounding fecundity in discovery and invention. Under these circumstances, the investors are doubtless justified in expecting to receive interest on their money from the moment they pay it in. This being a just and reasonable view, the company ought to provide for interest during the construction of a new project, and as a matter of fact it ordinarily must do so to attract people to invest in its securities, and thus furnish the money to carry out the project.

Money for all these expenditures must be raised before the completion of the plant. If the expenditures are not charged to the capital account, they must be raised by the creation of a debt to be paid off from operating receipts, which means that early users of the company's products must pay unduly high prices. The fair way is to charge all to the capital account, and let the receipts from service carry the interest on the investment for these items in the same manner as the interest for the investment in brick and mortar, steel and copper is carried. It is therefore unreasonable to criticize a public service company merely because its issued securities have a larger face value than the value of the physical property which may be set down in a schedule, but the situation should be carefully scanned to see whether the difference is beyond legitimate limits before criticism is passed.

The problem of fixing rates for public utilities falls into even greater difficulties when we come to consider the expenditures during operation. As in the question of the capital account, all expenditures that are illegitimate must be suppressed, but all legitimate and reasonable expenditures which go to improve or cheapen the service and advance the stability of the company must be provided for and allowed. The difficulties here are twofold: First, the difficulty of drawing an exact line between expenditures that should be allowed and expenditures that are not illegitimate but may not be of sufficient permanent usefulness to the company and its service to justify the expense. Second, the difficulty of determining in what manner and how extensively to provide for various perfectly proper future expenditures that will become necessary to prevent impairment of the capital.

Under the first of these categories come expenditures for several purposes, of which I will name only one which is very often criticized unsparingly, sometimes even in instances where a careful scrutiny would show that the disparagement is unmerited. The expenditures to which I now refer are those for advertising (or pertaining to the publicity, or new business department, as it is nowadays often called). It is a manifest truth that there can be no reasonable disapproval of advertising that results in a betterment of a company's operating condition so that it can better serve the public or afford its customers lower rates; but determining where this condition ends and a waste of money begins is largely a matter of judgment, and may not be conservatively done.

Difficulties of the second order above named, *i. e.*, those relating to provisions for expenditures which will become necessary in the future to prevent impairment of capital, mostly relate to conditions which impose reasons for gradually accumulating a reserve fund from which extraordinary demands for expenditures may be met. Depreciation of plant and the kindred accounts which may be known as "obsolescence" and "required reconstruction" are embraced within these conditions.

The technical meaning of depreciation is perfectly well defined. It is well known that any mechanical plant, however well cared for and kept up by current repairs, gradually deteriorates so that it must ultimately be replaced. A telephone company may find it necessary to rebuild an entire line of poles once in ten years, and an electric light company may find it necessary to replace a battery of boilers or an engine-generator set at the end of twenty-five years of useful life. Owning relatively few such units, these companies must treat the expense of such replacements as an extraordinary account, differing from current repairs which can be provided for month by month and year by year at a fairly uniform rate, depending upon the business. It is obvious that a company may not be able to meet the extraordinary expense referred to from the income of the particular year in which the replacement becomes necessary, and it is manifestly proper for the company to anticipate and prepare for the situation by accumulating and maintaining a reserve fund which will be sufficient to meet the replacement expenditures as they become necssary. This is the object of the depreciation reserve, or "reserve for reconstruction," as it is called by some, which is commonly maintained by electric light, electric railway and telephone companies. Its object is manifestly proper, and maintaining such a fund rests on the foundation of honest business judgment.

Two other factors are associated with depreciation in such a manner that they also must be provided for, by most public service companies, by the accumulation of a reserve fund to meet the extraordinary expenditures which they put upon the company at intervals. These factors relate to the development of the art, which may make an expensive plant obsolete before its natural life is run, and to the reconstruction requirements laid upon the system from time to time by legislation. The first of the factors is commonly referred to as "obsolescence," and it is a factor of much moment in those branches of the business in which the art is changing rapidly on account of fecundity of invention. If a telephone company installs and puts in operation an expensive switchboard and equipment of the most approved type of the day of its installation, but invention shortly thereafter produces apparatus by means of which much more convenient service may be afforded the telephone users, the company is soon forced by the clamor of its customers to substitute the new type of plant for that in use. This is an illustration of obsolescence. The plant in use might have years of natural life before it according to ordinary considerations, but the advance of the art rendered it obsolete; whereupon its replacement was necessary to maintain the business at a satisfactory state. The expense of this replacement might amount to a large part of the company's annual income, or perhaps more than the entire income for one year. It would be unfair to charge the expense of such replacements to the account of capital (bringing in new money for the purpose), as the company has no greater property after the replacement than before, and such a procedure would effectually preclude the possibility of any future reductions of rates to customers or improvements of service; but the proper way to meet the expense of such replacements is to provide a reserve fund, accumulated by annual additions after the manner of the depreciation reserve, and maintained for use when required.

The second of the two factors to which I am now referring differs from obsolescence in form, but possesses like characteristics in operation. I have called it "required reconstruction" for want of a generally adopted term. An electric light company may own a well-built pole line, in excellent condition, which borders a street upon which the city authorities order boulevard improvements, and the wires must go underground. The overhead line had been originally constructed according to good business foresight, as the improvement of this street was not then contemplated; but the required reconstruction involves a large loss on the pole line, because the salvage of material upon its removal is by no means equal to the cost of the construction of the line. A far-sighted consideration of the interests of the stockholders of the company, and of the public who are the company's customers, seems to me to call for making good this loss out of a reserve accumulation built up and maintained after the manner of the depreciation reserve. The cost of the new underground construction which replaces the pole line seems to be a proper capital charge, because the company possesses permanent property in that construction and the people living along the improved streets and buying the electric current from the cables may be expected to pay interest on that property. On the other hand, if the old pole line (now removed) is left in capital account, a load is put on future service which may preclude the further and constant improvements in character of service and plant which the public desire, and it seems to the advantage of the public to have the loss which is imposed on the company by the required removal of the pole line made good out of a previously accumulated reserve. The increase in the company's investment on which interest must be secured from the customers, which is caused by the transaction carried out in the manner indicated, is equal to the amount by which the cost of the new underground construction exceeds the then value of the removed pole line, and the sum which must be provided from the reserve fund in carrying out the transaction is equal to the first cost of the pole line, diminished by the salvage.

These three factors of depreciation, obsolescence and required reconstruction may therefore be treated as a unit in the bookkeeping of the company, and a single reserve fund may be accumulated and maintained for their support. As an engineering matter they are separate, but this does not prevent a suitable treatment of them as a unit in the bookkeeping. The commission appointed by the city of Chicago, some two years ago, to study the telephone system in that city, made a careful study of the sum of money which ought to be set aside each year so that the accumulated funds might adequately meet the requirements of these factors as they arise. The report of the commission points out that the annual addition to the accumulated reserve fund ought to average 8 per cent of the first cost of the plant, including the company's building, but not including its land. This 8 per cent is also separated by the commission into two parts: one, 5¾ per cent, to account for depreciation and obsolescence; and the other, 2¼ per cent, to account for estimated required reconstruction and a small proportion of fire insurance risk which, in this instance, cannot be economically placed with insurance companies. The apparatus of telephone companies is delicate and fragile, and the telephone art is in a period which is fertile with invention and improvements, which make the rate of depreciation and obsolescence quite large in telephone plants. These factors for electric light, electric railway and gas light companies are ordinarily counted at a lower rate than the 5¾ per cent computed by the Chicago commission for telephone investments in that city.

My object in dwelling at some length on these details is to bring forcibly to your mind the fact that the normal expenses of operation (including taxes) and the interest on invested money are not the only items involved in a consideration of what constitute equitable rates to be charged for its product or service by a public service corporation, but that reserve funds for reconstruction requirements (and sinking funds needed when the company operates under a fixed term franchise) must be given due consideration. This fact is very often neglected or forgotten in the course of criticism leveled against public service companies. Frank and reasonable criticism will never injure any right-minded corporation, but unjust criticism seldom comes to good. It is natural for the uninitiated to cry out for a large reduction in rates when he learns that the normal expenses of operation of a public service company, such as an electric light company, consume in a particular year (we will say) only 60 per cent of the total receipts from the customers. An average reduction of the rates by 25 per cent may appear to him to still leave a goodly margin for the stockholders, but his deductions are without substance because they are made in neglect of certain important factors which analysis would disclose. Reduction in the rates under consideration may be very unwise, because it may cripple the credit of the company, and thereby prevent it from obtaining money to continue a policy of extending its plant and widening the usefulness of its service. Such crippling of a well-managed public service company is likely to curtail the advantages which it can afford its customers (with whom the city itself is generally included, in addition to the large number of individual citizens), producing widespread inconvenience to a degree that far more than neutralizes any saving which the customers can make as the result of a small reduction in rates. In a particular instance which I have in mind, a reduction of the rates by an average of only 4 per cent would reduce the margin left for the return on the investment to 6 per cent of the invested capital, in case the other charges were duly provided for by the company out of its income. This is too narrow a margin on which to establish the success of an electric light or telephone company, for instance, except in the cases of the largest and most firmly established concerns which enjoy unlimited franchises.

The two bed-rock principles which I named in the early part of this paper seem to me to be equally applicable to the conditions existing in parts of the country which are new and yet to be developed, and in stable and well-settled parts of the country; and the same seems to me to be true of the considerations which I have discussed in association with the two principles. But the deductions cannot be drawn to apply unqualifiedly to all parts of the country. In new parts of the country, the need of the service and the advantages coming as a result of the service may be far in advance of the capital readily available for building plant to render service, and the risks of embarking in projects in an undeveloped region deter investors from furnishing capital unless every reasonable opportunity is opened by the governing authorities for the service company to earn extraordinary returns on the invested capital. The investor who is satisfied with 5 per cent return per year from an invest-

ment of proved permanency may with reason consider 10 per cent too small to overcome the risks which are united with the earlier years of a public service investment in a new but "hustling" western city which grants a franchise for a limited term of years. These risks involve many factors which are not found in general business, for a fixed investment in permanent plant must be made from which little salvage can be recovered in case of failure, and success may be accomplished only through shrewdly forecasting the character and rapidity with which the city will develop and appraising the stability and personality of its citizens. A manufacturer may ship his product elsewhere, a merchant may move elsewhere with small loss, but a local utility company is rooted to the ground, and the risks surrounding its existence when established in a new though hopefully developing country are correspondingly large. Such a company is also and additionally subject to the chances of ruinous competition, which may be brought on by speculators invading its field in a territory not yet rich enough to support adequately one company, and to the attacks of political and other "strikers" who wish for favors.

This leads me to a third and a fourth basic principle concerning the matter under discussion, which I will state in the following language:

3. A public service company in a new and developing country must see before it opportunity to earn returns on its invested capital which are very large compared with those adequate in stable and thickly settled regions, in order that it may secure the capital needful for developing its plant and extending its service to meet the apparent needs of an expanding but not yet stable population. If opportunities for honestly earning large returns on the investment in a new country are curtailed by legislation, the development of the service must become inevitably retarded to the disadvantage of the country.

4. A new company, even in a stable country, ought to earn more than current rates of interest for its investors whose enterprise enables them to take the risks of establishing the business, but the rate of return on the investment may be expected finally to approach current rates of interest after the business has become profitable and is firmly established on fixed franchise rights covering a long period.

The fourth principle points to the corollary that the public service companies, well established in the old and permanently settled portions of the country, which have elected to do business under franchises without term limits and are guarded from unjust competition, which conditions now exist in several of our states, must finally expect to give their best grade of service at rates which earn a margin for the investors which is little or no greater than the rate of current interest for tried and sound commercial investments.

The question of "what the traffic will bear" must always be an element in the determination of rates for public service corporations. This phrase, "what the traffic will bear," has a real significance of great merit, which differs from its popularly accepted meaning of taking all that the customers will give up. According to its correct meaning, it signifies that the charges made for service are adjusted as between the company and each of its customers, so that the company finds the dealings profitable with each, when the full situation is considered, and each customer receives service which as nearly as practicable meets his requirements and costs a price which makes the service advantageous to him, while no unjust discriminations between customers are allowed.

In passing, I will make a note that the last phrase does not involve equal prices to all customers, but does involve the treatment of all customers so that they obtain from the company relatively a full return for their money.

The test of equitable charges depends, first, upon their bringing in a total income sufficiently large to pay on the invested capital a return which is reasonable under the conditions of the location, after all normal current expenditures relating to operation are paid and adequately adjusted reserves are provided for. What a reasonable return on the invested capital may be is not a matter that can be fixed once for all or for all locations by dogmatic methods, but it is a matter which must be determined by a consideration of custom and the application of common sense to each instance or class of instances, in a manner analogous to the process by which the common law has developed.

The test of equitable charges depends, second, upon a fair distribution of the charges among the various customers, and here again fixed guides are lacking and the dictates of custom and common sense must intervene.

In consideration of the facts to which I have referred, it is plain that the test of equitable charges as between customers does not necessarily reside in all customers of a public service company paying at the same rate per unit for their service, or in the price for a given service being constant at all times. It has also been generally accepted that it does not reside in all customers so paying for their service that each pays cost plus a fixed percentage for profit. My own tentative answer to the question is: That the test of the reasonableness or equitableness of the rates maintained by a public service corporation is found in: (1) The effectiveness and simplicity with which the schedule classifies the customers, so that the total required income is collected in a manner which secures the same rate for all customers of a class obtaining approximately like service, though customers belonging in different classes, because they obtain service with differences of character which essentially affect the cost per unit, may be subject to quite different rates; and (2) the certainty with which the rates secure from each class of customers the full annual operating cost of the service in that class and such a proportion of the reasonable return on the investment as the customers' traffic can afford. It then becomes a matter of expediency and public policy to determine whether a company receiving a public grant is justified in taking a larger proportion of profit from one class of customers than from another.

Finally, to apply my criterion of the equitableness of rates requires a more effective organization of their cost keeping than has yet come into vogue with most public service corporations. A few of the companies have adopted their schedule of rates as the result of certain actuarial operations, but most of them have arrived at their schedules by the path of gradual modification through experience; and few can support the reasonableness of their schedules on a foundation of facts produced from their accounting records. I believe that this condition is in a fair way to be overcome. Acute attention is now being given by prominent public service companies of all kinds to studying the cost of service, and the making of improvements in records and in methods of analysis are considered with deep interest.

Some Features of Copper-Clad Wire

By William Marshall Page

OWING to the recent rapid developments in the electrical world, the demand for conductor wire has increased enormously. Telephony, telegraphy, electric lighting, and the many other applications of electrical energy would be impossible were it not for the manufacturers who convert bars of steel and copper into wire.

In the early stages of the electrical industry, a soft drawn copper wire was commonly employed for all purposes requiring high conductivity, but for overhead work, on account of the great cost of maintenance as a result of the recurrent breaking and the fact that only very short spans can be strung, soft copper being of low tensile strength, hard drawn copper wire came into service. Hard drawn wire gave many advantages, but only steel wire could be used where long spans were necessary, and as the steel soon rusted away and retained but a small part of its original conductivity, a demand was soon created for a conductor which, like the copper, would not rust but which would have a tensile strength greater than that even of hard drawn copper.

This resulted in many individuals and companies expending considerable time and money in endeavoring to develop a compound wire having a core of steel coated with copper.

Repeated attempts were made to manufacture a copper-covered wire by processes similar to that of galvanizing, and by electroplating. The usual method, however, adopted by most experimenters was that of forcing a steel billet inside a copper sleeve, and rolling the assembled metals to a wire rod, to be subsequently drawn into wire. All these attempts, however, were soon proven to be impractical, as at no place was there a perfect union between the copper and steel, and in use electrolysis soon set in, thus destroying the steel core. It is only recently that a process has been developed whereby copper and steel can be successfully welded together and rolled and drawn into commercial wire.

Copper-clad steel, as manufactured by the Duplex Metals Company, is trade-marked "Weld-Clad," since it is a material carrying copper and steel so firmly united that the union is in the nature of a weld, the only method of removing the copper from the steel being to melt it off. It will not yield to mechanical force or any other separating agency.

In brief, the process adopted consists in immersing a properly treated billet into specially prepared supermolten copper. This specially prepared copper is at so high a temperature and is so fluid that it readily impregnates the outer surface of the steel, and alloys of copper and iron are formed thereon. The billet is then drawn from the bath of copper and placed in a mold, care being exercised to avoid oxidation of the surface, and the requisite amount of pure copper is then cast around the billet into contact with the treated surface. By varying the size of the billet or mold, a copper coat of any desired percentage may be obtained. This composite billet is then rolled and drawn as in ordinary wire practice.

It may be readily observed from this that copper-clad steel does not consist of copper and steel welded together, but has a steel core and a copper coating permanently united through intervening layers of copper-iron alloys. These alloys are readily discernible under the microscope when a sample of the material is properly polished and etched.

Many of the remarkable physical characteristics of copper-clad are, undoubtedly, due to the presence and influence of these alloys. Corrosion tests have demonstrated that when the steel core of copper-clad wire is exposed, corrosion practically ceases at the expiration of forty days, and during the interim only progresses a short distance into the steel.

A test made by Booth, Gerrett & Blair of Philadelphia, sets forth that an annealed copper-clad rod ⅜ inch in diameter (only 60 per cent of the area of which was steel) had a tensile strength of 51,000 pounds, and an elastic limit of 89 per cent of its ultimate strength; while a bare steel rod of similar composition to that used in the core of the copper-clad, had a tensile strength of 54,000 pounds, and an elastic limit of 82 per cent. A sample of copper-clad from which the copper had been removed, showed a tensile strength of 61,000 pounds, and an elastic limit of 89 per cent. (It is noteworthy that the steel used in the core of the copper-clad rod and the sample or bare rod were of similar composition and were taken from the same bar.)

This not only demonstrates the high tensile strength of copper-clad material, but sets forth the fact that steel when worked under the protective copper coating is, undoubtedly, of much better texture than ordinary steel.

In overhead work, a certain amount of conductivity is required and also a certain amount of tensile strength. There must be enough conductivity for the current and there must be enough tensile strength for the spans required. In many instances engineers have been forced to employ much larger wires than are really necessary, thereby increasing the original cost of the line. When using copper, the wire would have to be too large in order to obtain the strength requisite while with galvanized wire it would also have to be too large in order to obtain the conductivity. But this is all eliminated in copper-clad steel wire. With this wire the requisite conductivity and the requisite strength can be obtained for any purpose without the use of unduly large wire. The strength of copper-clad is in the core, as may be observed from the above report showing the breaking weight of a copper-clad steel rod from which the copper had been removed. In view of this strength, nicks or surface damages which may occur in handling, or stringing the wire, which would cause an ordinary copper wire to break, have no effect upon the strength of copper-clad.

Standard copper-clad wire is manufactured with a conductivity of 40 per cent of that of pure copper, although any percentage of copper may be put on to give any desired conductivity, and steel of any composition to give any desired strength may be coated with equal facility. The following table presents a

comparison of breaking weights of copper-clad, copper, B.B., E.B.B., and galvanized steel of the same size, viz:

	Diameter in Inches.	Breaking Weight in Pounds.
Galvanized Steel	0.162	1,406
B. B.	0.162	1,250
E. B. B.	0.162	1,140
Copper	0.162	1,237
Copper-clad	0.162	1,874

An analysis of a report made by the Electrical Testing Laboratories of New York shows that at moderate current densities, the impedance of copper-clad steel wire is approximately equal to that of copper wire of the same resistance; therefore, ordinary calculations can be made on the basis of copper wire with a close degree of accuracy.

Engineers are rapidly becoming cognizant of the existence of copper-clad and it is going into extended use. Copper wire stretches and sags, which tends to decrease its cross-sectional area and increase its resistance; this increase in resistance also occurs in galvanized steel or iron due to its gradual rusting away; in copper-clad, however, the copper eliminates all possibility of corrosion while the tensile strength and high elastic limit of the steel core removes any possibility of stretching. Economy in the use of copper-clad steel wire is most in evidence when considered in connection with the open line plant, as the drawing charges on the sizes of wire used in open line construction do not form as large a percentage of the total cost as in the case of smaller sizes employed in cable, or inside wire plant, where conductivity, and not strength, is the most important factor.

Copper-clad steel wire of the same size is more economical per mile than copper. Not only is the price per pound for copper-clad less than copper, but its weight per mile is approximately 7 per cent less.

Owing to the failure of all former attempts to successfully coat a steel wire with copper, engineers have become more or less skeptical regarding compound wire, and for a time were prone to look upon copper-clad more as an experiment than a commercial possibility. In the last two years, however, more than enough copper-clad wire to stretch around the entire world has been sold, and is giving satisfactory service; in most cases the wire was strung in the worst places on the various lines.

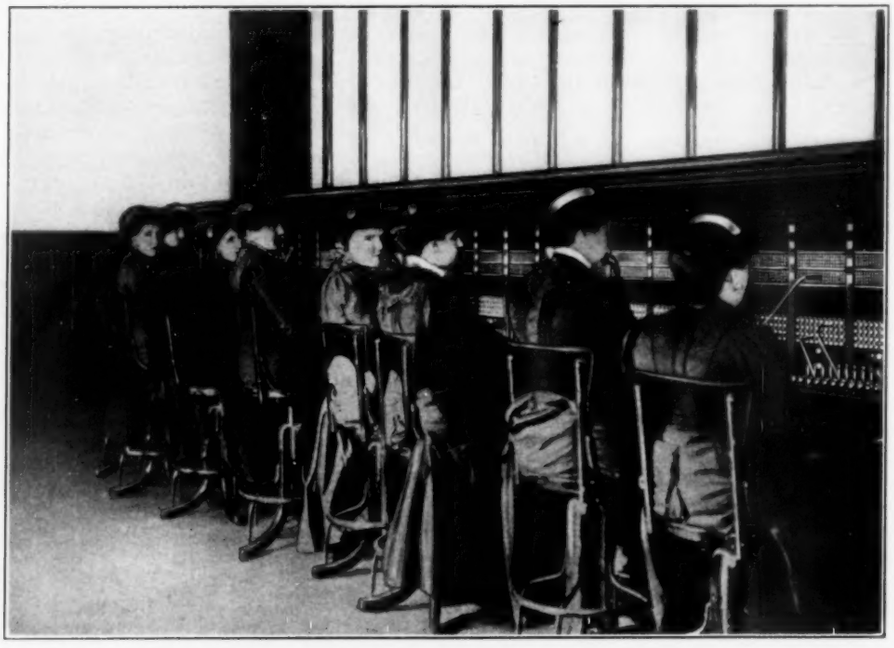
Telephone Service in Roumania

George A. Dorsey, who is "doing" Europe for the Chicago *Tribune*, says of telephone conditions in the city of Bucharest:

"Some of the buildings are even imposing in size, as, for example, the structure which houses the post, telephone, and telegraph. The telegraph and telephone service is efficient and wonderfully cheap, but one marvels at the red tape. For instance, you enter the anteroom of the telephone department, sit down at a long table, write out your number and thrust it through a hole in a great high wall. Then you sit down (having removed your hat on entering the room) to await your number. When the connection is made you are called behind the wall and are shown a booth. When you come out to pay your bill the operator has made the entry in four different books, from one of which he clips a coupon which he stamps and presents to you. But the bill for Budapest service, 570 miles, for example, is so small that it fairly bewilders one."

New Telephone Exchange at San Sebastian

The city of San Sebastian, Spain, has recently built a new telephone exchange building and equipped it with the newest and most improved apparatus. The illustration accompanying this article shows the switchboard, which is a type familiar to those acquainted with American telephone exchanges.



Exchange Operating Room, San Sebastian, Spain.

San Sebastian's new system is common battery, and the switchboard is in 11 sections, attended by 18 operators. The new exchange, which has a capacity of 2,000 lines, has lately been installed by the Bell Telephone Manufacturing Company at Antwerp, one of the allied houses of the Western Electric Company.

A little over a year ago this American concern filled a famous rush order for an exchange at Paris, the result of a fire which destroyed one of the principal exchanges in the French metropolis. The Western Electric Company has also recently contracted to build the first modern telephone exchanges in the city of Pekin.

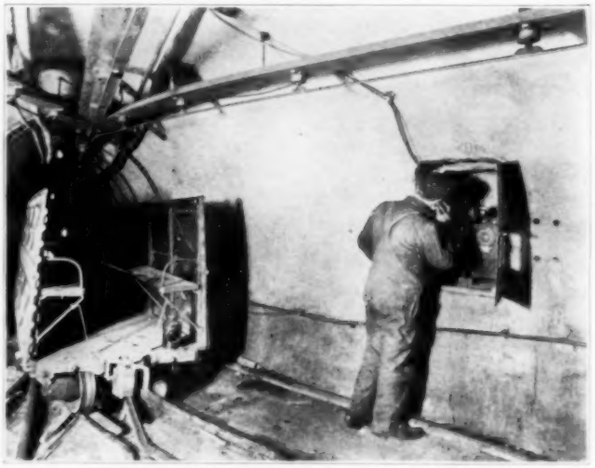
The San Sebastian equipment is identical in all respects with the No. 10 Western Electric switchboard which is used in this country in exchanges of the same capacity.

DEPARTMENT of RAILWAY TELEPHONES

Dispatching in Chicago's Tunnels

By William J. O'Neill

THE use of the telephone in train dispatching involves many problems which are quite complex. But the dispatching of trains along the surface of the earth, or in the air above the earth is simplicity itself compared with handling trains that are run through burrows in the ground scarcely larger than their own lateral dimensions, amid all the crossings, junctions and side tracks that any surface line could use.



Telephone Station in a Chicago Tunnel.

At the time the Illinois Tunnel Company's subway under the streets of Chicago was built, or rather excavated, it was probably the most widely discussed engineering feat of the times. The project of running electric locomotives and trains of freight cars through a subterranean bore ostensibly intended as a conduit for telephone cables was amazing, to say the least. Yet the underground railroad has operated successfully ever since it started, unseen and practically unknown to the people of Chicago, silent and efficient.

The tunnel's dispatching problem was the problem of guiding and protecting train operators whose direct vision could be of little assistance to them in keeping track of the movements of other trains. On a surface road the trainmen must assist their signals by their own observations; in the tunnel no observations can be made except in straight lines, and the whole responsibility rests on the dispatcher and his system.

The telephone train dispatching system of the Illinois Tunnel Company has very recently been perfected to such a point that all the unusual occurrences incident to the peculiar type of transportation are handled with the utmost ease and dispatch.

The whole system centers around the chief dispatcher's desk, which is the pulse of the system, and is of such importance that a chief dispatcher and assistant are always at hand to issue orders, and thereby avoid any confusion in the tunnel.

The Illinois Tunnel, now about sixty miles in length with several trunk tunnels and numerous branches, has an automatic telephone dispatching system of 250 stations. The dispatching switchboard is a desk with a drop panel three feet long and nine inches wide of very simple yet complete construction. This panel can be taken out for repairs or removal to any other desk at very short notice, and contains keys operating eight exclusive incoming and two exclusive outgoing lines. These are operated on a local battery circuit in connection with 110-volt commercial supply, and from the incoming cables to the telephones the system is complete and accurate in every detail.

Each key with its relay is wired and circuited with induction coils, buzzer and two 32 candle-power lamps in series. Six of the eight keys controlling incoming trunk lines are available to all train men who are expected to report at junctions, stations or at any time when special instructions, are necessary to their routing. One key is for

Department of Railway Telephones

This department is established as a permanent feature of TELEPHONE ENGINEER. The progress of the art of telephone train dispatching, its technical developments, its news, and the elucidation of its mysteries for the non-technical worker will be found each month in these pages. The editors invite the problems and solicit the co-operation of the many readers of TELEPHONE ENGINEER in all parts of the world whose interests lie along these lines.

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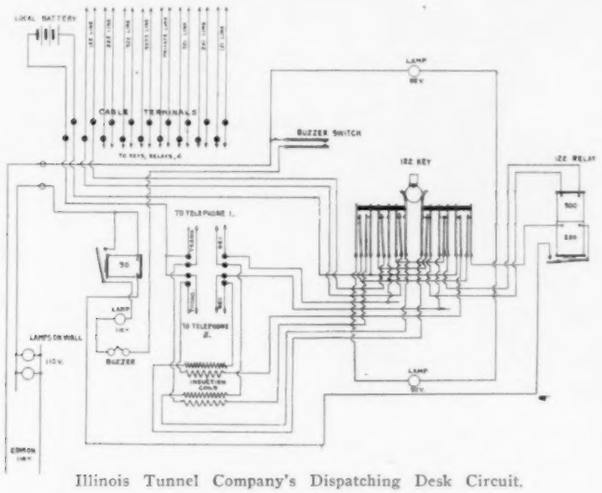
the exclusive use of foremen and their assistants who may need immediate connection with the train dispatcher's desk. The eighth key is for the individual use of the Tunnel Company's superintendent, and this call number is known to him only. Automatic telephones are used throughout the system.

Another attachment, which is of great advantage to the telephone company, is connected with the train dispatcher's desk and gives him immediate advice of every fire alarm sent in to the fire department by telephone. This enables him to take due care that any of the flood gates in the vicinity of the burning building may be closed if the tunnel is in danger.

The Stolken block signal system installed in the Illinois tunnel is very interesting, and is particularly suitable to the tunnel work as all electrical connections can be made, and in fact a good many are made, submerged in water. The usual block signals are used; green, giving permission to proceed, red, the danger stop signal and the notation "flag," proceed with caution. This system is far more simple and sure than the manual system entailing the hiring of watchmen who give all signals by lantern or flag.



Illinois Tunnel Company's Dispatching Desk Circuit.

When building the Illinois tunnel the city passed an ordinance that all crossings should be guarded by a policeman, but the block system has been proven so effective that this law has been over-ruled. When contemplating installing plug signals in the Illinois tunnel the lowest bid from established signal companies was $1,500 per station, and inasmuch as 400 stations would have been necessary, the sum of $600,000 would have been needed. This was entirely too much money to use in one branch of the service, and the system now used was installed for a great deal less money.

A brief description of the operation of this special block system will not be out of place here. The Illinois Tunnel Company's subway presented a different problem from any that had then arisen in the history of railroad construction. It presented a method of tracks, loops and crossings, interwoven like a spider's web, all of which must be protected by signal devices.

The apparatus for protecting an intersection of two tracks on each of which there is traffic in only one direction comprises red signal lamps. These red lamps are adapted to be lighted by a train on one track and thereby prevent a train on the other track from approaching the intersection and also prevent a rear end collision on the same track. After the train has set the signals in warning state, it crosses the intersection and departs, restoring all the signals to the normal no-signal state. In addition to the red lamps, a green lamp is provided on each track which indicates to the operator on an approaching train that his signals are working properly and gives him permission to go ahead. The apparatus to accomplish these results consists of "on" contactors placed beside the trolley wire, which are actuated by a train approaching the intersection, a relay working in oil to which conductors lead in from all the contactors, signal lamps whose circuits lead out from the relay and are controlled thereby, and "off" contactors placed similarly to the "on" contactors to be actuated by a train as it departs from the intersection.

In the same oil tank with the relay are simple switches, one for each track, which can be thrown over manually and thereby interchange each "on" contactor with its respective "off" contactor and also change the connections of the signal circuits, so as to adapt the system for traffic in a reversed direction.

In case two trains on respective tracks approach their respective "on" contactors at about the same time, the train which strikes its "on" contactor first, even though the difference be only one thousandth of a second, will get the green permissive signal to go ahead, while the other train will get a red warning signal to stop. But the relay is so constructed that when the first train actuates its "off" contactor on departing from the intersection, then automatically the red light, which holds the other train blocked from the intersection, will change to green, and all the other signals will change to correspond. Thus the second train is held until the first train clears the block and then the second train is given the right of way automatically.

In such a case as this, it will be noted that if rail contactors are used, then the first wheel of the departing train that strikes the "off" contactor will release the waiting train to go ahead; if thereupon the waiting train starts up immediately its wheels will successively actuate the "on" contactor on the corresponding track at the same time that the successive wheels of the departing train are actuating the "off" contactor on the other track. This would obviously confuse the signals. Therefore, when rail contactors are used a "time-element" is introduced so that a certain arbitrary time must elapse after the "off" contactor is actuated before the signals are affected thereby. This arbitrary time is made such that the departing train will surely entirely pass its "off" contactor before the permissive signal is given to the other train.

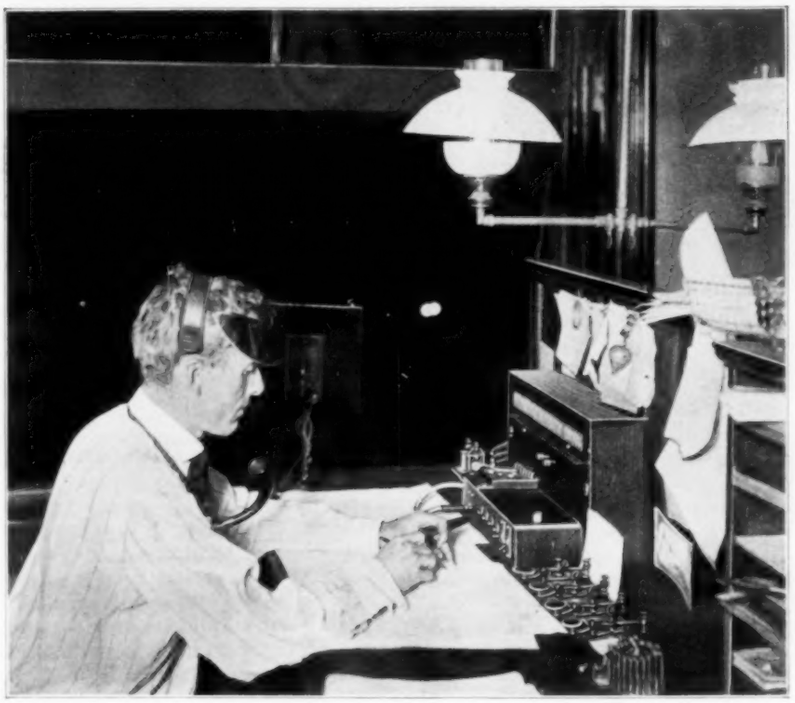
The time-element consists of a pendulum acting in combination with an electro-magnet and a ratchet wheel and pawl so that the ratchet wheel is stopped along one tooth at a time for each beat of the pendulum. The closure of the "off" contactor sets the electro-magnet to driving the pendulum and after the ratchet wheel has thus been moved a certain distance an electrical contact is closed (or broken) so as to actuate the relay and make the appropriate change in the signal circuits.

This time-element finds numerous other adaptations in the entire system. For example, in a modified form it is employed in a street crossing signal system to ring a bell for any desired arbitrary length of time after a train has approached within a certain distance of the crossing.

How the Wray-Cummings Selector Works

By G. A. Joy

LIKE many of the more important inventions, the first thought of the Wray- Cummings selector was due to a very small incident. While insignificant in itself, it was enough to start a mind with an inventive tendency to work and a mind of this type when once on the trail can be stopped only by success. Mr. Archibald Wray, while employed by the Chicago, Burlington and Quincy Railroad Company as telephone inspector, had been having considerable trouble with a system of selector that was being tried out under his supervision; so his mind was in a very receptive mood for any suggestion that might in any way aid him in solving his difficulties. While in one of the telegraph offices of the company a clock was being replaced by a new one, and in a joking sort of way the old clock was handed to Mr. Wray with the remark that he might be able to use it for something. He took it and it was not long before he did find a use for it. Before he had got the old clock to his headquarters he had in a general way conceived the idea of using a clock movement as a multi-station selector.

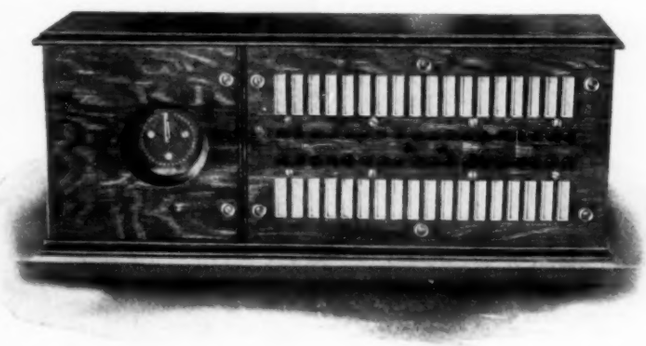


C. B. & Q. Dispatcher at Galesburg, Ill.

Like most inventors he had to put up with his ideas being ridiculed by his co-workers. Mr. Ryder, the superintendent of telegraph of the C. B. & Q. at that time, was not so skeptical but that he signed a requisition for the purchase of several clock movements for Messrs. Wray and Cummings to carry on their experiments. It was after much search on their part that they found a clock with the proper type of movement suitable for their purpose. It was not long after this that they had their ideas worked out so they were satisfied that the scheme was thoroughly practical. In March 1908 they equipped fourteen stations between Chicago and Aurora with their apparatus. This equipment was in use giving good satisfaction for over a year when it was replaced by the same type of equipment, only that it was made up in a more substantial form.

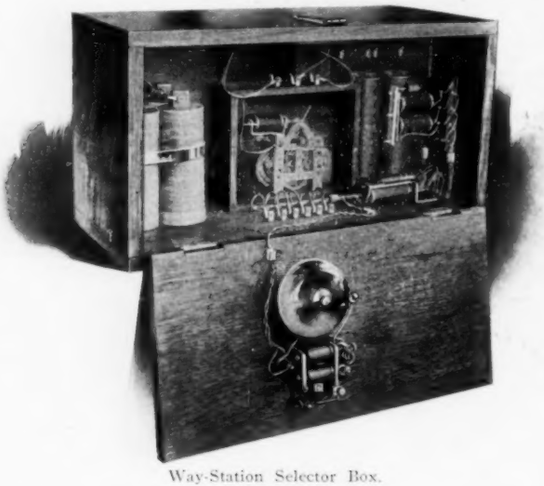
The principle upon which this scheme was worked out is usually spoken of as the synchronous clock movement, or, to be a little more simple, it consists of clocks moving together at the same rate.

A clutch or dog was placed on the second hand shaft in such a way as to permit the clock to run just one minute when once started. By raising the clutch the clock would be started and when the second hand shaft had made one complete revolution the clutch would again drop into place and stop it. This clutch was released by a magnet rigidly attached to the frame of the clock and when any station was wanted an electric impulse was placed on the line, which energized all the magnets thereby causing them to draw up their armatures, releasing all the clocks on the line at exactly the same instant. These clocks, as stated before, run for one minute only — or for the length of time necessary for the second-hand shaft to make one complete revolution, when the dogs again fall into their respective places, stopping the clocks in such a position that they would start up when released for another call. The second-hand shaft carried in addition to the clutch a commutator



Dispatcher's Selective Equipment.

or contact maker, which in the case of the dispatcher's set, consisted of a branch which, upon being revolved, passed over a stationary dial that had one contact for each station telephone on the line, while the substation commutators had only one contact which came into contact with a stationary brush once during a complete revolution. The contacts on the substation clocks are arranged at different positions on the circumference of the commutator, so that no two of them come into contact with their respective brushes at the same time.



Way-Station Selector Box.

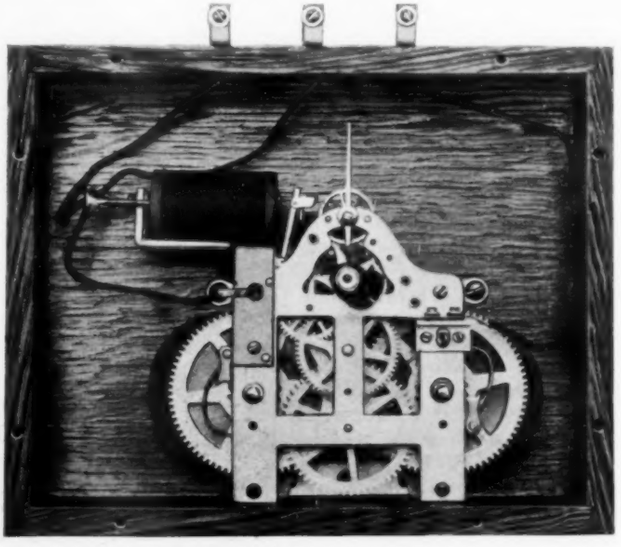
The dispatcher's set in addition to the clock with the before-mentioned contact maker had a key connected to each contact on the dial so that when any key was depressed and the clocks started a battery impulse was put out on the line during the interval of time that the contact brush was passing over the contact associated with the operated key. The contacts in the sub-station clocks were so placed that when the brush of the master selector rests on a contact one of the substation contacts is also made. For example the dispatcher desires to speak with the agent at way station No. 7. He first operates key No. 7 and then presses the starting key which releases all the clock movements in the system, and as the brush passes over contact No. 7 on the dial at the dispatcher's office, the selector at station No. 7 has caused its commutator to revolve so that the contact point has come under the brush; thus the two selectors together complete the necessary circuits at the same instant and consequently the relay is operated cutting the bell into circuit. This will continue to ring until the attendant answers. Should the dispatcher want a group or even all the station agents on the line at one time he operates such station keys as he desires, presses the starting button and each bell starts to ring in turn as the selector brush passes over the different contact points on the dial.

Such is the simple narrative of the design of the Wray-Cummings selector. As the selector is manufactured today by the Kellogg Switchboard and Supply Company there have been a few slight changes made but the general idea is the same as when first put into use by the C. B. & Q. Railroad. The changes made are in the way of adjustments and in adapting standard Kellogg apparatus to the satisfactory working of the selector.

The idea of selecting a large number of stations on a single wire is old for the scheme has been in use for many years on telegraph circuits for this purpose. This idea was originally used in telegraph stations when it was desired to call the operator to his key at night, and such other times that he would be away from the office. The selector device was located in the telegraph office and a pair of bell wires were connected to a night bell in the operator's room, which in most instances was on the floor above. By this means no trouble was experienced in reaching him when needed. The selector relays for this scheme were naturally in series with the line, so when the multi-station selector scheme was applied to the telephone circuit it was but natural that it should be of the series pattern. However, it would seem that we should have been above the series proposition in any form for telephone work long before this, but many prominent engineers insisted for some time that this was the only method to be employed for multi-station selecting.

It is claimed that Messrs. Wray and Cummings were the first to insist on a bridged type of selector. This was used by them on the C. B. & Q. several months prior to inventing the selective system bearing their name; their idea being that better transmission could be had over a bridged line, and that the equipment was easier to protect from lightning and less liable to be put out of commission due to the ordinary line troubles than a series system.

So far, little has been said about any of the apparatus excepting the selector itself. The talking equipment itself should of necessity be of a type best suited to long distance transmission. The transmitter is really the most essential piece of the whole talking equipment. The one best suited for long, heavily-loaded lines must produce talking currents whose amplitude is great and at the same time the continuity of the circuit should not be broken. There are but few transmitters on the market that will fill the requirements necessary for satisfactory transmission on dispatching lines. On lines that are often over two hundred miles in length and having as high as forty stations bridged across, one familiar with telephone work



Selector Clock Movement.

can easily realize that the problem of furnishing a satisfactory quality of speech transmission is considerably complicated. The telephones are of the local battery type, as it is conceded by all that local battery transmission is far superior to common battery for long-distance work.

A few words as to the amount of attention that is required by the Wray-Cummings selectors might not be out of place here; nothing, however, need be said about the line and telephone maintenance, as this is pretty thoroughly understood by all. In the first place, since all selectors are of the clock type it is very evident that they must be wound up at certain intervals. The selectors as manufactured are designed to make five thousand calls without rewinding. Since the number of messages on a busy dispatcher's circuit rarely runs over two hundred per day and it is evident that one winding of the clocks will last from three to four weeks without rewinding. Another item of maintenance is the dry batteries used for operating the relay bell at each station. The life of these batteries depends in a very large measure on the alertness of the station agent, for the signal bell continues to ring until the receiver is removed from the hook. Other than the above mentioned maintenance items there is very little in the way of expense.

Train Dispatching by Telephone

By C. H. Gaunt*

WE have not yet reached the stage of progress where one might ask, "Is the telegraph doomed?" Certainly it is not doomed when its application to the transmission of intelligence to great distances is taken into consideration nor when we reflect upon the great wireless projects of the future. But there is one direct use of telegraphy that is seriously disturbed, and that is its application to the necessities of modern train dispatching.

The important invention of Morse had scarcely been offered for general use before it was seen that it could be availed of in the movement of trains upon railroads. The recognition of the assistance of the telegraph service in threading trains through the sidings, straight stretches and curved sections of a single track railroad is practically coincident with the adoption of that service for sending messages of a social and business nature.

The year 1851 saw the first systematic attempt to telegraph "orders" from a central point to the engineers and conductors of trains, and, from that time down to the present, train dispatching and the telegraph have been inseparable. Thousands of our youths who have looked with longing eyes and stimulated imaginations to the railroad as the goal of their ambitions have started their careers by learning the art of telegraphy, because that seemed to be the most certain means by which they might sit in the chair of the train dispatcher, a most coveted place—a place from which great railroad generals are drawn, a position of responsibility well worth the metal of any man, and by far the most important single occupation connected directly with the movement of trains.

The trainmaster must be virtually a mistakeless man. He is the commanding general of train movement, and the engineers and conductors are his field marshals. The great single-track railroads of the west have developed a body of serious-minded men for this work whose mental equipment is of a high order. The game that they play with the trains under their control is one that does not permit them to take a single chance. It must be played to perfection. The train dispatcher is the chess master of railway train movement, and he must win every game. Where a mistake means death or the great destruction of property, or both, then the absolute elimination of mistakes is the one great effort; and in no branch of railway operation has that effort been more fruitful of results than in the development of experienced men and first-class machinery to handle an indefinite number of trains in all kinds of intricate maneuvers without accident and with the least delay.

The telephone has been in general use just about thirty years. At the very start the question was asked "Why cannot this improved means of transmitting words be used in the dispatching of trains?" The grave and earnest men whose mental machinery seemed to work to perfection through the instrumentality of the telegraph said "No." The high officials of the railroads did not feel that the well working system was susceptible of change without risk, and risk is always to be avoided when there is not an immediate and good reason for assuming it.

Hardly a man of large influence in the field of train operation advocated the supplanting of the telegraph by the telephone during the first twenty-five years of the latter's successful use. Even after the clear long-distance transmitter had been generally established the railroad managers hesitated to interfere with the long wedded union of the telegraph with train movement. But the fine, practical minds of our great railroad managers have to be suddenly changed sometimes when a combination of circumstances brings about a result that has not been foreseen. Some may claim that the use of the telephone in dispatching trains has long been advocated. Possibly so, but only during the last few years have trials been made of sufficient importance, and upon a large enough scale, to prove anything. When proof is demanded by a practical-headed train dispatcher, it must be capable of but one construction —*absolute*.

The Santa Fe established its original telephone train-dispatching circuit in June, 1908, in the dry climate of Colorado. It was not fitted with the improved apparatus now available, but there could be only one construction placed upon the reports received upon its operation—it was a success. As soon as this was realized immediate steps were taken to extend the introduction of the system to widely separated sections of the lines so as to test it in all conditions of climate. During the early part of 1909, 1,962 miles of telephonic train-dispatching circuits were in operation upon the Sante Fe Railway in the states of Mis-

* *Santa Fe Employees' Magazine.*

souri, Kansas, Illinois, Colorado, New Mexico and California. The longest circuit reaches from Fresno, Cal., to San Francisco, 203.1 miles, contains thirty-two stations and is successfully operated through the "fog belt" adjacent to San Francisco, where the telegraph is used only with great difficulty. The operating circuit upon all of these lines is a pair of 210-pound-per-mile copper wires carefully strung and costing in the neighborhood of $100 per mile. There is at present under construction 1,520 miles more, which will give a total length of about 3,482 miles of telephone circuits.

The results of this extensive trial, while really astonishing, should hardly be so considered, for they are but the natural consequence of human tendency, and an anaylsis of the telephone method will convince anyone that it will almost completely displace the use of the telegraph in moving trains, notwithstanding the expense of installation and the difficulty in overcoming the force exerted by the widespread use of the telegraph method.

The telegraph is used by the train dispatcher in the intricate operation of his trains for one purpose only, that of communicating with the operators scattered along the stretch of railroad. Long use has developed a certainty of action in telegraph manipulation that commands the respect of all. But how often has a half frantic dispatcher, loaded down with the complicated problems before him, wished he could use his voice to the men with whom he must communicate and thus avail himself of the rapidity of action, the definiteness and security that would follow?

To the dispatcher time is the one thing that must receive the greatest consideration. It may be assumed that a man can utter words with a speed equal to the operation of his mind. But the train dispatcher, in using the telegraph, has always been obliged to transmit his words at a speed but one-tenth his capacity to express himself, and also to receive a reply at the same rate. That being the case, of course a train-dispatching system had to be adopted that would deal with a very small number of expressed ideas, and eternally and always the dispatcher must come down to the limitations of the telegraph. In other words, the whole operation is inharmonious and does not tend to a result along the most natural channel. True, in the issuance of "orders" themselves, the speed, in telephonic manipulation, is limited to that required to write the words in longhand. But all directions of a collateral character, the receipt of important information and the instantaneous descriptions of situations that a dispatcher must understand can be given and received at a speed limited only by that of human utterance.

And what does that mean? It means that the dispatcher has been permitted to multiply the time within which he may form his plans of train operation fully three times. This, of itself, further means that his mental calculations are vastly improved in accuracy and general value. The dispatcher is permitted to issue his orders at the times he originally outlined, and there is a coherence, a consistency and a union in his methods not possible where less time is available. This condition largely reduces the liability of error of action and, conversely, allows additional time for the discovery of error, important or unimportant.

By the use of the telephone the dispatcher is relieved of the long continued and aggravating operation of calling an office by repeating over and over the telegraphic letter or letters used for that purpose. There is established at each office along the road, in the same circuit with the telephones, a small and compact instrument called a selector. Connected with the selector at each office is also an electric bell operated by a couple of cells of dry battery. The dispatcher has within easy reach a number of buttons upon a board, each button being designated by the name of the station that it is designed to call. By merely pressing such a button the selector in that particular station is operated, to the exclusion of all others, and in a few seconds the bell is ringing loudly. And, to show the completeness of this calling arrangement, the dispatcher also hears in his telephone receiver the flutter of the bell and therefore knows that it is ringing. The despatcher can stop the call when he likes, and a short ring generally arouses an immediate response. But, if not, the call may be continued until the answer is received, something that does not often occur, because an excuse for not answering does not have the same weight where a bell rings loudly that it does where an instrument may be feebly ticking off the call. And if it were not enough that the time used in calling offices should be practically eliminated, there is the further advantage that these calls may be made upon the line at the same time telephonic conversation is being carried on, one operation not interfering with the other.

If the operator at the station wishes to communicate with the dispatcher, he simply removes the telephone from the hook, places it to his ear, and if there is an opening for him he states the name of his station and the dispatcher instantly replies by saying "Dispatcher." The "reporting" of trains—that is, the stating of the time of passing or of the arrival and departure of trains at stations—is made to the dispatcher much more quickly than is possible by telegraph, and, where messages are necessary, they may be transmitted by telephone with the speed at which the operator and dispatcher may be able to write longhand, and with equal accuracy to the telegraph. Information regarding derailments or other trouble is conveyed to the dispatcher by verbal and complete narrative, either by the station operator or the conductor of the train involved, so that the dispatcher is in immediate touch with the situation, while in using the telegraph for this purpose message after message is required before there is a complete understanding of the details.

In transmitting "orders" by telephone, the dispatcher spells out in full the names of stations, numbers of engines and trains, the time and the proper names involved. This, however, is done with speed and precision, and the dispatcher writes the order in the record before him as he gives it, not waiting to make the record when it shall be "repeated" to him by the operator, as is done in the telegraph operation. This change in making the record of the order from a subsequent to an initial one is very important from the standpoint of absolute accuracy.

Unquestionably there are doubters still of the complete success of the telephone in train dispatching and the allied services. The change—if it shall come—from the use of the telegraph to the telephone in moving and making up trains, in the handling of the thousand and one details connected with the immediate motion of traffic and in giving to all the employes concerned in the work the benefit of the interchange

of judgment through direct conversation, is revolutionary.

But it brings quick action where formerly it was slow. It takes from the dispatcher the necessity for operating his trains through the medium of a large number of telegraph operators of varying ability. It brings to bear upon this most important of services direct conversational contact between all the interested parties, something of greater value to this particular work than can be fully described. There is harmony of action, harmony of temper, human understanding and personal relations of the most satisfactory character. There is the certainty that more movements will be better planned and executed, and that the art of direction of operation of trains will be greatly advanced and the work more safely rendered.

Telephone Train Dispatching News

The Georgia Railroad will install within the next few weeks telephone equipment for dispatching trains between Augusta and Atlanta, Georgia, a distance of 171 miles, and from Camak, to Macon, Georgia, a distance of 74 miles. There will be twenty-eight regular stations and five siding telephones on the line from Augusta to Atlanta, and twenty regular stations from Camak to Macon. The Georgia installation is the first one in that section of the country.

Railroads in the south have recently been very active in adopting the telephone method of handling the movement of trains. The Southern Railroad has purchased from the Western Electric Company equipment for the installation of telephones and selectors on a portion of its line, and it is reported that the equipment of the other divisions on this road will soon follow.

The Chesapeake & Ohio has completed the installation of similar equipment on the Cincinnati division and expects to have installed within a short time equipment for handling train movements by telephone on three of its other important divisions.

The Norfolk & Western Railroad has equipped a large portion of its line with telephones, and plans to cover its entire system as soon as possible.

The Seaboard Air Line has installed the telephone on two of its divisions, and reports that the operation of telephones for handling train movements is so satisfactory that the extension of the service is being considered.

The Atlantic Coast Line has for some weeks been handling train movements on one division by this method and plans to extend the service on other important divisions as soon as construction work can be completed.

The Boston & Maine Railroad has taken steps to equip two new divisions of its line with telephone equipment for train dispatching. One of these extends from Concord, N. H., to White River Junction, Vt., a distance of 70 miles, and the other from Concord to Woodsville, N. H., 95 miles. Each circuit is to be equipped with 25 way stations. On the first of these divisions the dispatcher is located at Concord and on the other at Woodsville.

In September, 1909, the Boston & Maine cut into service its first telephone train dispatching circuit between Boston and Fitchburg, Mass., a distance of about 51 miles. Service on this line has proved so satisfactory that orders have recently been placed with the Western Electric Company for complete telephone and selector equipment on the two new divisions.

The officials of the road are reported to be well pleased with the new method of handling train movements. They are planning to push the work of equipping their entire system with telephones and selectors.

The Great Northern Railroad will use telephones for train dispatching over the entire main line.

Train Orders by Telephone

A paper by W. W. Ryder, formerly superintendent of telegraph of the Burlington system, and now holding the same office with the New York Central lines, describes some of the advantages of the telephone over the telegraph. Mr. Ryder says that the first experiment on the Burlington in the handling of trains exclusively by telephone began December 11, 1908, on the main line between Aurora and Mendota, Illinois, 46 miles, with eleven station offices. The experiment has been so successful that the Burlington now has installed the telephone dispatching system on 286 miles of its line, on double and single tracks, and with sixty-five station offices. The results are thus summarized:

The use of the telephone is so quick in every way and so much more flexible that the dispatcher gets far more detailed information of what each train is doing than was possible by the use of the telegraph. When occasion requires, talking can be done directly with the conductor or the engineer. Marked improvement is observable in the work of the men on the circuits, as conversations between operators and the dispatcher are of more personal nature than obtains with the telegraph, resulting in closer co-operation. There is a saving in time in transmission of orders; the dispatcher copies the order into his order book as he talks it off, thus reducing his speed of conversation to his own ability and that of the receiver in writing out; when operators repeat the order they talk it off faster than is possible by the use of the telegraphic key.

It is easier to train telephone operators than it is to find good telegraphers. There is much to be gained by making use of men in their own home towns, or who have grown up along the line. The increased use of the telephone opens an avenue for better employment to those unfortunates injured in service. Then, too, it broadens the field from which the road must secure the material from which train dispatchers can be made. Heretofore, the first requisite for such an officer was ability to telegraph; and the growth of railroads increased the difficulty in securing competent material for this important work.

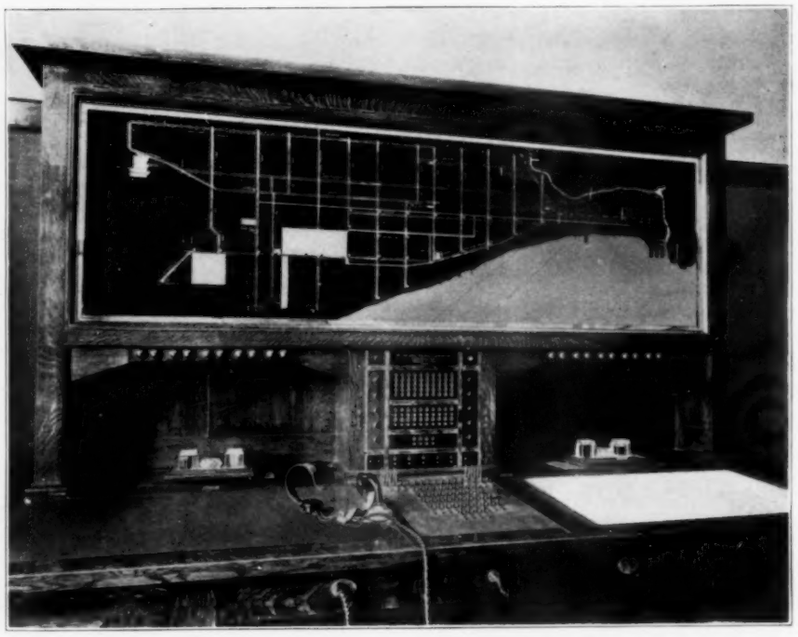
Mr. Ryder maintains that the bright young freight conductor who has been carrying out train orders is better able to assist in getting other trains out and in than is the telegraph dispatcher, who is a train operator only in theory.

The telephone works as well in bad weather as in good—just the reverse of the telegraph—and good service is most needed when the weather is bad, wet or foggy. The telephone establishment, too, enables the road to close unimportant stations wholly or a part of the time, as the telephone instrument can be installed where the trainmen can readily get in touch with the dispatcher. With the telephone it is possible to arrange apparatus so that the superintendent can at any time supervise the actual work of train handling.

A Unique Dispatching Switchboard

By George Harmon

THE telephone switchboard shown in the illustration accompanying this article is used by the Chicago City Railway Company in dispatching and operating its electric cars. The lower part of the board is practically of standard construction furnished with the usual answering jacks and lamp signals, a listening key being placed in each circuit and connected with the operator's head receiver so that he can answer a call without the necessity of plugging in. The unusual part of the apparatus is the large map which occupies the upper part of the switchboard cabinet. This map shows all of the streets in Chicago upon which the Chicago City Railway Company has car lines operating. It is seven feet long and thirty inches high, and is covered with a heavy plate of beveled glass.



Dispatcher's Switchboard of the Chicago City Railway Company.

At frequent intervals along all of the company's car lines are telephone stations in iron boxes. They are located along the edge of the sidewalks and resemble the boxes used for fire alarms, except that they are painted green. Each conductor is furnished with a key that will unlock any of these boxes, and in case of an accident, delay or other emergency he is instructed to telephone the operator at the dispatcher's office from the nearest box. Of course, each of these telephone stations connects with an answering jack in the switchboard and has its line signal lamp adjacent to the jack, but the most interesting feature of the system is that every one of these road stations is connected with another signal lamp located on the map in the switchboard at an exact point corresponding to the location of the station. When a conductor lifts the receiver of one of these telephone stations both lamps on the switchboard are lighted, one indicating the answering jack, and the other one on the map showing the location of the originating call. This double signal avoids error due from misunderstanding and mistakes of the operator in referring to a list to see just where a particular telephone box is located. In other words, the operator is graphically informed just where the distressed car conductor is telephoning from, so that the matter can be given the quickest and most accurate attention possible. While the switchboard is not of the cordless type is nevertheless has a key for each of its stations so that the operator need not use the cords in answering calls.

At the ends of the various divisions of the street car system car starters are located. These are also provided with telephones that terminate upon the same switchboard, so that they may reach the dispatcher at any moment. By this means they are always informed immediately of any delays occurring on the system so that if necessary cars can be sent around the blockade by some other line.

This system has been found of great assistance in following the printed schedule which is used in operating the cars. In fact, before the system was adopted it was found quite difficult to adhere to any schedule.

In most dispatching systems of this kind the telephones along the road are for outgoing calls only and have no signaling apparatus. Those used by the Chicago City Railway Company, however, are all furnished with loud ringing gongs operated by the usual ringing apparatus from the switchboard. In this way a car can be headed off at any point, it being the duty of the crew to answer a call issuing from any box along the road.

New Railway Telephone Association Formed

Pursuant to a call of a temporary committee, a number of manufacturers' representatives assembled in New York on February 9 and organized the Railway Telegraph and Telephone Appliance Association, the membership consisting of associate members of the Association of Railway Telegraph Superintendents.

A constitution along the lines of that of the Signal Appliance Association was adopted, and the following officers elected for the ensuing year:

P. W. Miller, chairman; Kerite Insulated Wire and Cable Company.

A. P. Eckert, vice-chairman; National India Rubber Company.

Hiram M. Buck, secretary-treasurer; Railroad Supply Company.

The primary object of this association is to make arrangements for the display of telegraph and telephone appliances by members of the association at the annual meeting of the Railway Telegraph Superintendents Association.

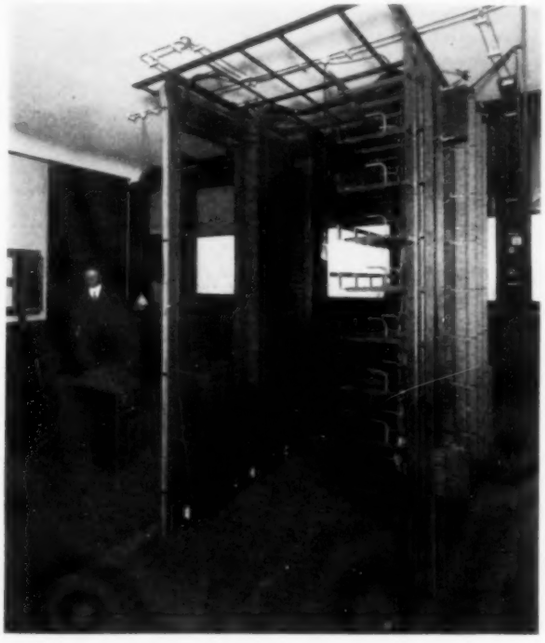
The names of the executive committee will be announced later.

Of Interest to the Trade

New Kellogg Installation

Three flourishing little cities in Arizona—Prescott, Globe and Bisbee—have recently installed common battery multiple switchboards. These are the four-party harmonic multiple type, and the only up-to-date common battery multiple plants in the territory; in fact, the territory has only one other common battery plant.

We can not fail to be pleased at the progress of the great southwest in the telephone field. The east has always been the criterion for people who wished to be up-to-date, but some of us could well look westward for our standard, at least in telephone matters. Although thinly populated, the towns and cities of that section are making a remarkable growth, and the citizens are wide awake and demand the best. Their



Terminal Room, Prescott, Arizona, Exchange.

main ambition seems to be to excell their eastern brothers.

All three plants were equipped and installed by the Kellogg Switchboard and Supply Company. In the illustration the Prescott terminal equipment is shown. The board is in two multiple sections, each section being six-panel, two position, with a capacity of 3,000 multiple jacks. Golden oak is the material used throughout in the cabinet work. The board is equipped with 520 lamp signal line circuits and 20 rural and toll lines. Three operators handle the city lines, while a fourth has the rural and toll lines.

Fifteen standard Kellogg, double supervisory cord circuits comprise the equipment for each regular subscriber's operator, and ready means of testing cord and line circuits are provided. The standard Kellogg breast plate transmitter and head receiver is used by each operator. A matter deserving special attention is the manner of lighting. Each section is lighted by electric lamps placed in trough reflectors. The wiring for these lamps is run in iron conduits throughout the board and reduces fire risks to a minimum.

A standard built fire-chief's desk is convenient for testing work. The equipment is placed so that top of the desk is free for writing or other work, and is free from cords and plugs, all circuits terminating in keys.

The power plant is most complete, being furnished with duplicate sets of storage batteries and duplicate ringing equipment. The sets of four frequency vibrating pole changer and transformer sets make up the ringing equipment. The equipment is universally used in Kellogg four-party plants with the greatest satisfaction. The storage batteries are charged by means of mercury arc rectifier, accepted generally by telephone engineers as the most economical and efficient method of charging storage batteries from alternating current.

New Books

TELEPHONOLOGY, by H. R. Van Deventer, is the latest addition to telephone literature. It is a book of nearly 600 pages and covers very thoroughly the whole art of telephony. Beginning at first principles, the characteristics of sound and the operation of the human ear are explained, and from that point the author passes through an explanation of magnetism and the fundamentals of electricity into a description of simplest telephone circuits. Chapter Two enters into the serious technical features of the work with a description of signaling equipment. The principles of simple alternating currents as used for telephone signaling are explained and various forms of ringers, generators and switch-hooks are described. In this chapter also the proper windings for coils are calculated; and practical suggestions are given from time to time, calculated to be of value, as, for example, the construction of simple magnetizing devices for restoring demagnetized bars, etc., and directions for rewinding burned-out coils. Under commercial talking equipment modern transmitters and receivers are considered and the various commercial types are compared. Considerable interesting data on induction coils is included in the same chapter. The chapters on magneto instruments and circuits and magneto switchboards are thorough and interesting. Selective and lookout systems are treated quite thoroughly, and practically all types that are on the market today are explained and described. The chapter on batteries is very complete, and although not very long, it forms a treatise in itself. The chapters on testing and fault location form a useful guide for practical work, supplemented by an excellent chapter on measuring instruments and their uses. The portion of the book devoted to common battery equipment is quite large, and all of the commercial circuits and devices are described and illustrated.

Harmonic party-line systems are given a whole chapter, and this includes directions for the proper installations and care of such systems. There is only one chapter on line and cable construction, but what

there is of it is thorough and up-to-date, and includes practical directions for making joints in cables and other work of that nature.

The chapter on the automatic telephone system is practically non-technical and well calculated to explain that complex proposition, although it is confined to the description of one system. The last two chapters in the book are devoted to composite systems and wireless telephony. The chapter on composite work is very interesting in view of the recent affiliation of telephone and telegraph systems in this country. The chapter on wireless telephony is practically devoted to a description of the Collins system, and while it contains little new information, is of considerable popular interest.

Taken all in all the appearance of Telephonology is an event in the telephone world. The library of telephone literature is all too small, and when we can add works of such importance as this we may well feel encouraged. Illustrations always add greatly to the value of any reference book, and this book has nearly seven hundred of them, including diagrams, drawings and photographic reproductions. A purely mechanical criticism may be made of the arrangement of the type pages. The lines are too long and too close together for the single column arrangement. The effect is offset in a measure, however, by being broken up into short paragraphs and by the use of large indention. Bound in cloth covers. Price $4.

The Telephone & Telegraph Engineers' Pocket Book is, as its name indicates, a small leather-bound volume constituting a reference book convenient to carry in the pocket. Its physical size is just 5¼ by 3¾ by 1 inch, so that it is a pocket book in size as well as in name. It contains all of the rules, formulas, tables and circuits most generally used and needed by the linemen, wiremen, troublemen, wire-chiefs, superintendents, etc., engaged in telephone and telegraph work. There are about four hundred pages in the book; but they are small, and the treatment of some subjects is necessarily brief, although in most cases ample for the purpose. However, the treatment of those subjects which are of particular interest to workers in the field, such as electric measurements and the location of faults, is quite complete. The selection of tables is good, and the diagrams used are simple and readily explained. Some space is given to wireless systems as well as composite practice. Taken all in all this valuable little book ought to be popular. It is published by the International Text Book Company and was prepared under the supervision of Henry S. Webb, principal of the School of Telephone and Telegraph of the International Correspondence Schools.

American Electric Fuse Wins Connector Patent Suit

The American Electric Fuse Company, Muskegon, Mich., has just received news of a decision in its favor, filed February 14, 1910, in the United States Circuit Court for the Southern District of New York, upon Patent No. 521,018, covering double tube connectors for telephone and telegraph wires. This suit has been pending about six years. Testimony has been taken in a large number of different cities. The subject matter involved was what is known as the American improved double tube connector for splicing telephone and telegraph wires. This connector has been manufactured by the American Electric Fuse Company for the past ten years and under the decision just rendered the rights of that company are fully confirmed in all respects.

The company has guaranteed all connectors manufactured by it against any infringement claims of others and in the suit just won the rights of all of the customers of the company have been finally adjudicated.

The American Electric Fuse Company is well known as a large manufacturer of connectors as well as other electrical specialties, and has built up a big business in these lines. It is the announced policy of the company to defend all of its customers upon any patented articles manufactured by it.

Kellogg Company at the South Dakota Convention

The members of the South Dakota Independent Telephone Association were agreeably surprised at the large display of switchboards, telephones and apparatus of the Kellogg Switchboard & Supply Company. The company was represented by J. C. Kelsey, sales manager; G. A. Joy, sales engineer; H. N. Faris, manager of the Kansas City branch, and A. D. Carter, state representative. These men devoted their time to the entertainment of their many friends as well as explaining and demonstrating new and interesting features of their apparatus.

Mr. Carter was fortunate in securing a large, well lighted room in a prominent location in the Cataract hotel, in which to place the display. A hundred-line express type switchboard, illustrating the latest and most approved type of magneto equipment, was shown in actual working conditions. The one thing in this board that attracted most favorable comment was the double clearing-out feature. This equipment is becoming nearly universal wherever series telephones are used. Several telephones of various types were connected to this board, illustrating not only the quality of the transmissions, but the several methods of signaling.

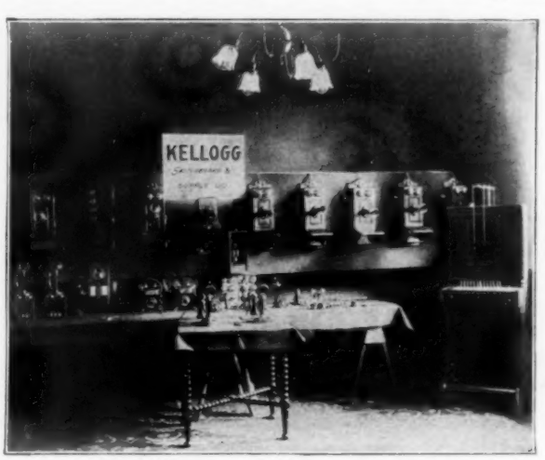


Exhibit of the Kellogg Company in South Dakota.

While South Dakota is not a very extensive user of common battery equipment, all were interested in the operation of the 200-line private branch hotel board. The line equipment was of a type using no relays and was specially arranged for convenience in

handling hotel calls. The two points of most interest were the ease with which all the telephones connected with the board could be rung at one time as a fire signal by the operation of a single key; and the suitability of this board for hotel work, in that the clerk or other hotel attendants can answer any room call without the use of any of the cord circuits—all that is necessary being to throw a common listening key. The operation of the key also connects a desk stand on the hotel clerk's desk in such manner that he can answer all room calls by merely removing his receiver from the hook.

The telephone men were pleased to see a satisfactory type of ringing equipment for long rural lines. Demonstrations were made over artificial lines up to thirty miles in length and with eighteen telephones bridged across the line. There were three different types of ringing machines shown. All were of the vibrating type, but adapted for different conditions.

A large display of both magneto and common battery telephones as well as many other pieces of apparatus was shown.

From a Kellogg standpoint, the convention was a decided success. Orders were taken for two magneto switchboards, a large number of telephones and considerable miscellaneous equipment and supplies. On the whole this was one of the agreeable gatherings of telephone men visited in many a day.

C. D. Boyd has been appointed Michigan representative of the Kellogg Switchboard and Supply Company with headquarters at Grand Rapids, Mich. He has a wide acquaintance among the telephone interests of the central states, and his success as a salesman is well known.

C. Morsman has been transferred from the Michigan territory to the newly created Rocky Mountain district.

B. Woodbury has been transferred from Minnesota to Ohio district, with headquarters at Columbus.

R. G. Lawrence has been appointed Minnesota representative.

G. A. Joy has been appointed sales engineer, territory west of Chicago, Ill.

Court Decides for "Noark" Fuses

In a decision handed down by the United States Circuit Court of Appeals for the Second Circuit of December 14, 1909, the Johns-Pratt Company, of Hartford, Conn., was upheld in its contention that the Sachs Company, and Joseph Sachs, its president, have infringed the Sachs patent for enclosed safety fuses, No. 660,341, belonging to the Johns-Pratt Company. In the opinion rendered by the court the patented invention is described as "a thin flat metal fuse-strip of extended area in contact over its entire surface with non-conducting filling," and it is said "that the novelty which the patentee sought to secure consisted in making the fuse-strip of thin flat metal of extended area instead of a wire or other strip having a compact sectional area, the object being to increase the surface of the metal with which the filling is in contact, so as to insure its immediate dispersion, when fused, in the filling material." The court holds that the flat strip fuses of the Sachs Company contain this patented invention and are infringements of the patent. H. W. Johns-Manville Company, New York, is selling agent for these fuses.

Stromberg-Carlson Dispatching Bulletin

The Stromberg-Carlson Telephone Manufacturing Company has just issued its bulletin No. 1001, the title of which is "Dispatcher's Signals for Electric Interurban Railroads." The pamphlet contains twelve pages devoted to a treatise on the use and value of dispatcher's signals in general, a description of the apparatus involved in the Stromberg-Carlson system, diagrammatic illustrations showing the arrangement and operation of the apparatus, and letters of approval from officials of traction companies using the system.

The company has also issued an interesting booklet on intercommunicating telephones, their uses and equipment. Either of these bulletins may be had upon request.

New Quarters for Belden Company

The Belden Manufacturing Company has recently moved into its new factory at 23rd street and Western avenue, Chicago, and with the advantages of more and cleaner space, ideal shipping facilities etc., is in far better shape to fill orders in a prompt and satisfactory manner than heretofore. The building is of the mill type construction, and is equipped with an automatic sprinkling system throughout. The windows are of wire glass, and the building is divided into two sections by a fire wall. A railroad track entering the building facilitates rapid shipments, and as the new quarters are considerably larger than those formerly occupied at 27 W. Michigan street, they are prepared to serve their customers on short notice with their well known line of cordage, webbing, sleeving, etc., magnet, resistance, switchboard, jumper, annunciator, and, in fact, all kinds of wire used in interior telephone work.

Western Electric Reports

New York-Western Electric's new fiscal year started under auspicious circumstances. December showed an increase in orders booked over preceding December of about 60 per cent. While totals for December do not run large, since November, the last month of the company's business year, is the month of cleanups in building, the large gain for last December is significient of what the year may be expected to show.

Throughout 1909 and to date in the current year gains in the business of the company have been well distributed over the various departments, indicating a sound expansion. Officers look for a continuance of that expansion during the current year and in this connection a man in close touch with the company's affairs says:

"Western Electric Company is looking forward to an increased business for 1910, not only in the business with the associated telephone companies, but

also with telephone customers outside the Bell system, both of which will feel the results of improved business conditions.

"Industrial plants and central stations are either getting ready or have prepared for a greater volume of business for 1910, which will make them larger consumers of motors and electrical supplies. We are looking forward, therefore, to a continuance of the steady improvement evidenced during the last year."

Indications point to especial improvement in motor, dynamo, telephone apparatus and cable lines. The sale returns of the company's "Hawthorn" products are very satisfactory.

Western Electric now has about 18,000 employes, having materially increased its operating staff since the commencement of its new year.

During the last year the company spent about $1,000,000 in enlarging and increasing its Hawthorn plants, which began full operation last spring, and are running on full time now. Stockholders held their annual meeting on February 3, in Chicago.

A new bulletin (No. 1105) has just been issued by the Western Electric Company describing in minute detail its intercommunicating telephone systems. The bulletin contains 40 pages of descriptive matter, showing the different combinations of systems on which the new Western Electric metal intercommunicating telephones may be used. It also contains the wiring diagrams necessary for the installation of these systems. All parts of the instruments are described in detail and well illustrated.

The bulletin furnishes valuable information to those who are interested in intercommunicating telephones. A copy will be sent to any address on request.

Other bulletins issued by the company describe its new No. 1317 type magneto wall set, rural switchboard No. 106, telephones for railway work, the No. 1317-AH bridging telephone, a wall type composite set, portable telephones for railway service, and the Gill selector for train dispatching. Any of these bulletins will be sent to interested parties on request.

Recent bulletins issued by the Western Electric Company treat upon the subjects of inter-communicating telephones lead covered cable. The booklet on cable describes and illustrates the process of manufacture of that product in the big cable plant of the company.

A Handy Resistance Table

The Driver-Harris Wire Company is distributing a very handy little pocket resistance table giving the resistance per 1,000 feet at 20 degrees centigrade, the weight per 1,000 feet bare, and the maximum safe carrying capacity of Nichrome, Climax, Advance, German silver, and copper wires in sizes from 1 to 40 B. & S. gauge. The table consists of a sliding card in a celluloid casing, the casing being slotted to facilitate quick observation of the table.

New Building for American Steel Co.

Mr. Allen, secretary of the American Steel and Wire Company, states that the company is erecting a new steel ware house in Seattle, Wash., to cost $150,000, which will enable it to handle in better shape the Pacific coast sales. The company has formerly rented a ware house, and hopes with the advantages of the new building and its new and up-to-date stock to be able further to verify its statements as advertised that it supplies the world with wire.

A Novel Transmitter Booklet

Owing to the many calls for the novel transmitter booklet recently issued, a cover illustration of which is shown herewith, the Kellogg Switchboard and Supply Company has gotten out a second edition; copies of which will be sent to interested telephone men on request.

This little booklet is made in the exact size and shape of the celebrated Kellogg transmitter; the front cover showing the highly polished nickeled face of the transmitter, with the mouthpiece, the name "Kellogg," and the number of the series which is now considerably over nine hundred thousand. The inside front cover is a reproduction of the inner face of the instrument; showing diaphragm, bridge, electrode, linen gasket and outer rim.

The outside back cover shows the rear of the transmitter, with the company name and patent number as it is in the actual apparatus.

The booklet is well illustrated with disassembled cross section and detailed views; while the reading matter is a complete description of the working parts and classification of the different styles of transmitters. The booklet will be sent by return mail on request. In this connection it is interesting to note that during the last year more than seven thousand transmitters of other makes have been replaced by Kellogg transmitters.

Keystone Company at Philadelphia

One of the most interesting features of the electrical show held recently in Philadelphia, was the working exhibit which the Keystone Telephone Company had installed. Not only did the company give service from its exhibit over its entire system, but it also operated an intercommunicating telephone system between all of the booths in the exhibition hall.

The American Electric Fuse Company has just opened a branch office in St. Louis and has placed C. L. Brackett in charge. Mr. Brackett will be sales manager for the company in its St. Louis territory and will be located at No. 1526 Chemical building. A complete stock of telephone protector apparatus, black enamel wire, rheostats, spark coils and igniters will be carried.

Mr. Brackett for the past seven or eight years has been special representative for the McCord Manufacturing Company, Chicago and Detroit, and is particularly well known among the railroad and automobile firms.

Brevities of the Business

PERSONAL NOTES.

Sherburne Davis Levings, erstwhile technical eutor of a New York telephone weekly, is today, March 1 assuming the responsible position of director of publicity for the Waterbury Company, 80 South street, Island of Manhattan—makers of cables and things. In an unguarded moment, long before he had his eyes riveted upon the cable job Levings dropped his photo into a case where we would be apt to find it in a "squeeze play." Presumably, there will come to us some of these fine days a formal notice telling all about the transfer from 80 Wall to 80 South. We are getting in ahead of that. Sherburne Davis is a lively little thing with nerve enough to tackle a mountain lion in the open. The Waterbury Company is taking on a man out of the West who has found the East fascinating. He will render good service and lots of it. Whisper: Hand it to him—he's a horse for work!

Gansey R. Johnston, general manager of the Columbus Citizens' Telephone Company, Columbus, Ohio, was recently chosen general manager of the United States Telephone Company of Cleveland. The United States Company, of which F. A. Davis of this city is president; Edwin R. Sharp, vice-president, and J. C. Brush, manager, includes ten subsidiary companies, which, with 15,000 in Columbus and Franklin counties, have about 42,000 telephones in service and about 16,000 miles of toll lines. The offices of the company will be removed from Cleveland to Columbus. Mr. Johnston will retain his position as general manager of the Columbus Citizens' Telephone Company.

Edward L. Barber recently passed through Chicago on his return from an extended trip to the western coast.

A. J. Berry has been appointed manager of the Marion County Telephone Company, Marion, Ohio, to succeed D. M. Odaffer, resigned.

C. E. Betts, manager of the Atchison Telephone Company, Atchison, Kans., has taken a position in the contract department of the Independent Telephone Company, St. Joseph, Mo.

Charles L. Zahn has been made engineer in charge of the construction of the Independent telephone properties at Spokane, Wash., controlled by Thaddeus S. Lane and associates.

James S. Brailey, Jr., of Toledo, Ohio, recently tendered his resignation as president of the New Long Distance Telephone Company, of Indianapolis, and will spend some time in the south, after which, it is said, he will devote his attention to other business interests.

William Fortune, who succeeds James S. Brailey, Jr., as president of the New Long Distance Telephone Company, has been placed in full charge of the independent telephone interests in Indiana, now controlled by J. P. Morgan & Co., and is himself largely interested in the ownership of the property. Mr. Fortune is also head of the Indianapolis Telephone Company and the New Telephone Company, is a director in the various subsidiary companies in Indiana and is chairman of the executive committee of the local and long distance companies.

Louis Hollweg, who has been identified with independent telephone interests in Indiana from the beginning, has been elected vice-president of the New Long Distance Telephone Company and also of the Indianapolis Telephone Company. He is also a member of the executive committee of both the Long Distance and Indianapolis companies.

CONVENTIONS.

The regular annual meeting of the Ohio Independent Telephone Association will be held at the Hartman House, Columbus, Ohio, March 17.

At a recent meeting of the executive committee of the Indiana Independent Telephone Association, held in Indianapolis, it was decided to hold the annual convention May 17 and 18 at South Bend.

NEW TELEPHONE COMPANIES.

GRAND VALLEY, COLO.—The Enterprise Telephone Company has been incorporated by M. E. Morrow, R. W. McGirk, G. P. Crawford and R. O. Gardner.

PUEBLO, COLO.—The leading citizens of this city are organizing a telephone company with a capital stock of $50,000 for the purpose of installing a local system.

EASTON, ILL.—The Easton Farmers' Mutual Telephone Company has been incorporated with a capital stock of $2,000 by J. S. McKinley, C. W. Kennedy and A. Tomlin.

WILMINGTON, DELA.—The Automatic Telephone Company has been incorporated in this city by W. T. Spring, F. J. Hensel and J. M. Lindsay; capital stock, $1,000,000.

WILMINGTON, DELA.—The Ecuador Long Distance Telephone Company is the name of a new organization recently incorporated in this city by F. M. Shive, S. E. Roberson, H. W. Davis, with a capital stock of $1,000,000.

GREENVILLE, ILL.—The Bond County Telephone & Telegraph Company has been incorporated with a capital stock of $43,020 for the purpose of operating telephone and telegraph lines. The incorporators are C. D. Holles, A. M. Keith and A. J. Parsons.

OAKWOOD, GA.—The Oakwood Telephone Company has been organized by O. A. Hughes, W. R. Barnwell, John W. Bell and J. M. Sheffield.

GAINESVILLE, GA.—The Mt. Vernon Telephone Company has been organized by R. I. Holland, president; Claude L. Thompson, and J. H. Conner.

EL PASO, ILL.—A charter has been granted the Farmers' Enterprise Mutual Telephone Company. The capitol stock is $800 and the incorporators are John W. Pleasant, Thomas Enright and Ira Stine.

CLEGHORN, IOWA.—The Liberty Central Telephone Company has been organized.

GRANVILLE, IOWA.—The United Farmers' Telephone Company has been organized by J. F. Georgen, Frank Holles, Christ Grady, N. J. Blatt and B. Hoefler, for the purpose of operating a telephone system in Granville and vicinity.

LACONA, IOWA.—Articles of incorporation have been filed for the Lacona Western Telephone Company. The incorporators are Lon Puderbaugh, T. H. Vincent, W. H. Funk, Alvin Miller, F. E. Miller, Robert E. McGee, C. E. Funk, Clarence H. Vincent, T. L. Wallace, D. L. Puderbaugh, H. E. Meeker, C. N. McFarland, C. A. Wickett, J. T. Vincent, Samuel G. Sinift, J. Hendrickson, J. L. Mills, R. Kimrort, J. Z. Snuggs, John A. Cleveland.

HARTLEY, IOWA.—The Sauers Telephone Company has been incorporated with a capital stock of $1,000. The incorporators are J. O. Sheldon, Henry Linder, S. Longbottom, F. P. Walters, Henry Zahn, Louis Spect, H. Amesiburg, H. F. Stoeteran and Wesley Walters.

BUTTERVILLE, IND.—The Butterville, Hyde and San Jacinto Telephone Company has been incorporated by C. M. Silver and others.

MILLVILLE, IOWA.—The Millville Farmers' Telephone Company has been incorporated with a capital stock of $9,900. The incorporators are George Friedman, John A. Smith, M. C. Miller, G. W. Welsh, John H. Becker, John Livingston and others.

WOFFORD, KY.—Articles of incorporation have been filed for the London Telephone Company with a capital stock of $5,000 by A. N. Perkins, I. N. Jones and John Bryant.

HALL, KY.—The Lower Beaver Creek Telephone Company has been organized by Ben D. Hall, R. L. Hall and others to establish a telephone system in Hall and vicinity.

HIGH ROCK, KY.—The High Rock Telephone Company has been organized by J. W. Willis and others; capital stock, $800.

POOR FORK, KY.—Robert Holcomb, John M. Huff and others are interested in the organization of a telephone company to operate a telephone line extending from this place to Gordon via Hurricane Gap.

PORTLAND, ME.—The North Atlantic Wireless Telegraph & Telephone Company has been incorporated with a capital stock of $500,000. The officers are as follows: President, H. M. Fairbanks; treasurer, H. T. Waterhouse, Portland.

AUGUSTA, ME.—The United Service Company is the name of a new organization recently incorporated in this city with a capital stock of $125,000. The officers are as follows: President, R. Z. Buzzell; treasurer, E. J. Pike, both of Augusta.

La Grange, Me.—The La Grange & Medford Telephone Company has been organized with a capital stock of $5,000. It is the purpose of the company to operate a telephone system in La Grange, Bradford and Medford.

Fergus Falls, Minn.—The Parkers Prairie Farmers' Telephone Company has been organized with the following officers: President, N. P. R. Nelson; vice-president, Axel Olson; secretary, Frank E. Larson; treasurer, Charles Moll.

Helena, Mont.—Articles of incorporation have been filed with the secretary of state for the Deerfield Mutual Telephone Company of Deerfield, Fergus county, by M. A. Johnson and others; capital stock, $12,000.

Butte, Mont.—The State Telephone & Telegraph Company has been chartered to construct and operate telegraph, telephone and electric light wires within the state of Montana. The capitalization is $500,000 and the incorporators are John Steadman, Wilford Tretheway, Irving Whitehouse, J. F. Taylor and M. B. McKay, all of this city.

Missoula, Mont.—A certified copy of the articles of incorporation of the Intermountain Construction Company has been filed with the county recorded by T. S. Lane, L. O. Evans and H. B. Brown. The company is capitalized at $100,000 and will carry on the business of building telephone, telegraph and electric light lines, plants and exchanges as well as to conduct a general contracting and brokerage business. The principal place of business will be Butte, but the company will carry on the work in all the counties of Montana and other states. The directors of the company are as follows: N. M. Jones, T. S. Lane, H. B. Brown.

Stanford, Mont.—Application has been made for a charter for the Stanford-Empire Telephone Company; capital stock, $25,000.

Troy, Mont.—The Troy Telephone Company has been incorporated with a capital stock of $40,000 by Charles A. Hurd, G. W. Waters, W. S. Dingee, W. F. Doonan, John B. Chase and William B. Milnor, all of Troy.

Paxton, Nebr.—Articles of incorporation have been filed for the Paxton & Elsie Telephone Company with a capital stock of $5,000. The incorporators are D. A. Lawler, J. C. Percy and Wm. Robertson.

Mayflower, Neb.—The Kinkaiders Telephone Company has been incorporated by Geo. S. Holtzlander, Chas. A. Johnson and E. H. Evans; capital stock, $6,000.

Pittstown N. J.—The Franklin Telephone Company has been incorporated with a capital stock of $100,000. The incorporators are Morris H. Leaver, Quakertown, N. J.; Thomas C. Robertson, Harmon K. Wright and Elmer F. Dalrymple, all of Pittstown.

McCook, Nebr.—The McCook Telephone Company has been organized by Harry Barbazett, J. W. Hatfield and J. E. Kelley.

Barrington, N. H.—Articles of incorporation have been filed by the barrington and Strafford Telephone Company.

New York, N. Y.—The Sanitary Telephone Transmitter Company has been incorporated to manufacture and deal in telephones and electrical apparatus. The capital stock is $100,000 and the incorporators are J. Tatlock, A. L. Clark and H. A. Crosby, all of New York City.

Oran, N. Y.—The Lewis & Hall Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are George M. Lewis, Roger D. Hall, Benjamin V. Lewis, A. F. Lewis, M. K. Lewis, Chas. E. Hall and William E. Kane, all of Oran.

Pawling, N. Y.—Articles of incorporation have been filed for the Pawling Telephone Company. The capital stock is $10,000 and the directors are J. L. Haynes, C. E. Baker, Charles Townsend, and H. A. Holmes of Pawling and M. C. Marsh and F. E. Cole. The company will operate in Pawling with lines extending to Dover, Hurd, Corners, Mizzentop and other towns.

Port Dickinson, N. Y.—The Port Dickinson and South Ogden Telephone Company has been organized with W. T. Haney, president, and Earl J. Beckwith, secretary.

Edenton, N. C.—T. C. White of Edenton and Dr. J. R. Parker, of Tyner, are the principal stockholders in the Chowan Telephone Company, recently incorporated with a capital stock of $10,000 for the purpose of constructing and operating a telephone system in Tyner and Edenton and the surrounding country.

Beach, N. D.—The State Line Mutual Telephone Company has been incorporated by Fred A. Powers, J. H. O'Keefe, J. A. Miller, Jacob Uelfers, Albert Henney, Albert Heijsman and Henry Winerice, of Beach. It is the purpose of the company to construct and operate systems throughout Billings county, N. D., and Custer and Dawson counties, Mont.

Cestos, Okla.—The Oklahoma Mutual is the name of a new company formed by the consolidation of the Union Mutual Telephone Company and the Independent Telephone Company of Mooreland. The directors are as follows: F. M. Littlejohn, J. H. Brown, J. W. Hays, Ed Campbell and F. E. Leonard.

Orwell, Ohio.—The Orwell Telephone Company has been organized by George L. Kingdom and others with a capital stock of $2,000.

Urbana, Ohio.—The Foreign-American Automatic Telephone Company has been organized by Paul A. Staley for the purpose of entering into the manufacture of automatic telephones.

Oklahoma City, Okla.—The New Telephone & Telegraph Company, which proposes to establish an automatic telephone exchange in this city, has been chartered with a capital stock of $50,000. Announcement is made that the capital will shortly be increased to $250,000. The diretors are E. C. Barnes, Charlton Barbour and Ross N. Lillard, all of this city. The company is said to be backed by C. E. Zahn, an independent telephone magnate, of Columbus, Ohio.

Stillwater, Okla.—Monroe Boyd, A. K. Maxwell, Harvey Hays, A. A. Brown, J. H. Blaugh, Louis Ventrie and J. N. Bigler, all of this place, are the directors of the Paradise Telephone Company of Payne county, recently incorporated with a capital stock of $200.

Pawnee, Okla.—The Skeedee Valley Telephone Company has been incorporated with a capital stock of $200. The officers of the company are as follows: President, Walter Buzan; treasurer, E. M. Willard; secretary, W. S. Slead, directors, Ed Zalosky and John Rudder. It is the purpose of the company to operate lines in the vicinity of Pawnee.

Woodward, Okla.—The Prairie Gem Telephone Company of Woodward county is the name of a new organization incorporated by J. S. Lucas, L. Foster, and C. E. Moran, Woodward R. F. D. No. 1. The capital stock is $500.

Pond City, Okla.—A new telephone company has been organized at this place for the purpose of taking over the Rural Telephone Company with a view to improving and extending same. The officers of the company are: President, A. M. Welsh; secretary, C. M. Van Sickle; treasurer, W. B. Wagoner.

Driscoll, Okla.—C. A. Minson of this place, among others, is interested in the incorporation of the New State Mutual Telephone Company, with a capital stock of $10,000.

Gracemont, Okla.—The Gracemont and Aney Telephone Company has been organized by T. M. Franklin, E. C. Luchan and H. E. Horwedel.

Nehalem, Ore.—Articles of incorporation have been filed for the Nehalem Telephone & Telegraph Company by S. Scovell, R. Zweifel and George R. McKimens. It is the purpose of the company to take over mutual telephone systems in the northern part of Tillamook county and greatly improve the same.

FINANCIAL ITEMS.

Phoenix, Ariz.—The Overland Telephone Company has floated a bond issue of $150,000, the money to be used in making extensions.

Covina, Cal.—The Covina Home Telephone Company is making arrangements to increase its capital stock from $50,000 to $200,000. This system serves 1,500 subscribers and is owned entirely by local capital.

Sandwich, Ill.—The United Telephone Company has increased its capital stock from $700 to $1,000.

Surprise, Neb.—The Surprise Telephone Company has been granted permission to increase its capital stock by $5,000, making the total capitalization $88,300.

Oakland, Neb.—The Burt County Telephone Company recently organized to take over the plants at Oakland, Lyons and Decatur, has made application to issue $75,000 in stock.

Red Hook, N. Y.—The capital stock of the Red Hook Telephone Company has been increased from $5,000 to $50,000.

Port Jervis, N. Y.—The Port Jervis Telephone Company has filed a certificate showing an increase of its capital stock from $4,000 to $6,000.

Greenfield, Ohio.—The Greenfield Home Telephone Company has increased its capital stock from $30,000 to $40,000.

Oberlin, Ohio.—The capital stock of the Oberlin Telephone Company has been increased from $6,000 to $35,000.

Kutztown, Pa.—The Kutztown Rural Telephone Company has doubled its capital stock increasing it from $10,000 to $20,000.

Orbisonia, Pa.—The Orbisonia Telephone Company has filed notice of increase of capital stock from $10,000 to $50,000.

Nashville, Tenn.—The Home Telephone Company, of Cannon county has filed an amendment showing increase of capital stock from $2,000 to $4,000.

Canadian, Texas.—The Canadian Long Distance Telephone Company has increased its capital stock from $20,000 to $40,000.

DEL RIO, TEXAS.—The Del Rio & Western Telephone Company has amended its charter providing for an increase in its capital stock from $60,000 to $80,000.

STANTON, TENN.—The charter of the Stanton Telephone Company has been so amended as to permit of an increase of its capital stock from $2,000 to $3,000.

BROWNTOWN, WIS.—An amendment has been filed by the Browntown Telephone Company increasing its capital stock from $5,500 to $19,800.

TRENTON, N. J.—The Delaware and Atlantic Telephone Company has filed an amendment increasing its capital stock from $100,000 to $10,000,000.

CLINTON, ILL.—At a meeting of the stockholders of the National Telephone & Electric Company the capital stock was increased to $300,000. The following are the officers elected for the ensuing year: President, B. F. Wasson; secretary and treasurer, V. R. Wasson; directors, the above officers and C. D. Martin.

MINOT, N. D.—The Northern Telephone Company has increased its capital stock from $10,000 to $20,000.

SWANWICK, ILL.—The capital stock of the United Telephone Company has been increased from $710 to $1,000.

EDINBURG, N. D.—The Edinburg and Gardner Telephone Company has increased its capital stock from $10,000 to $20,000.

FRANCHISES ASKED AND GRANTED.

TIDIOUTE, PA.—The borough council has granted the Forest County Telephone Company a franchise to construct and operate a telephone system in this place. The new system will be operated as an auxiliary to the Petroleum Telephone Company of Oil City.

GRANBURY, TEXAS.—The Acton Telephone Company has been granted a franchise to build its lines into this city.

CLARKSBURG, W. VA.—The Consolidated Telephone Company of Fairmont has been granted a thirty year franchise in this city, and will at once begin the construction of a new and thoroughly up-to-date system. Underground cables will be installed and modern equipment of every kind used. The city reserves the right to take matters in hand should rates become too high, or in the case of sale to another company.

SERGENT, KY.—The Letcher County Home Telephone Company is seeking permission to construct a line from Sergent to Pound, Va., via Craftsville, Vilas, Wright and Pound Gap.

JACKSON, MISS.—The Home Telephone Company has applied for a franchise to install a system in Natchez.

MUSKEGON, MICH.—The Citizens' Telephone Company is seeking a franchise to construct and operate a telephone system in this city.

SALINA, KANS.—The franchise recently granted E. Hageman for the construction of a telephone system, has been transferred to C. L. Brown, Abilene, Kans.

GEORGETOWN, DEL.—The Trinity Rural Telephone Company has been granted right-of-way between Millsboro and Stockley.

WAUKEGAN, ILL.—The Rocky Mountain Bell Telephone Company, through its attorney, W. G. Downing, recently submitted a proposed ordinance granting the right to own, maintain and operate a telephone system until January 1, 1934.

WAUKEGAN, ILL.—The Illinois Lakes Light & Power Company asks the board of supervisors for a franchise to install and operate a telephone system in Lake county. The request was made by Girard A. Ellingson, president of the company. The company which is incorporated at $250,000, now owns the light and telephone plants at Crystal Lake, is negotiating for the poor plants at Barrington, Grayslake and Antioch and plans to furnish power and light, as well as telephone service, to all western Lake county and eastern McHenry county.

MARMADUKE, ARK.—The Marmaduke Telephone Company is asking permission to enter the city of Paragould with its system.

NEWPORT, KY.—The Citizens' Telephone Company has been granted a franchise in this city which provides that a mile of conduit must be laid the first year, and a half mile each year thereafter, until four miles have been constructed.

ROCHESTER, MINN.—J. A. Melone has made application for a new franchise for the Rochester Telephone Company. The old franchise expires in five years and the company desires a renewal of its franchise before making provision for the large amount of extensions and improvements which it is planning.

MT. CLEMENS, MICH.—The Macomb Telephone Company, through its representative, Gordon O'Keefe, is seeking an amendment to its franchise. Owing to the poor service the business men have taken over the stock of the old Macomb Telephone Company with a view to improving the service.

CARLISLE, KY.—Franchises have been granted the East Tennessee Telephone Company, also L. C. Griffiths, of Louisville, to construct and operate a telephone system in this city.

FERGUS FALLS, MINN.—Owing to a proposed increase in rates for the present telephone service, business men have applied to the city council for a franchise to construct and operate a new telephone system.

MANSFIELD, OHIO.—The Wayne County Telephone Company has been granted a franchise by the city council, to construct and operate a telephone system.

MEDFORD, ORE.—C. E. Sharp has been granted a franchise to install a telephone system in this city.

BOONEVILLE, KY.—The Booneville Telephone Company has secured permission to construct a line from Booneville to Sturgeon.

MISCELLANEOUS.

GRINNELL, IOWA.—An important deal has been consummated whereby the Iowa Telephone Company has taken over the toll lines of the Long Distance Copper Company and will operate them as a part of its system.

MINNEAPOLIS, MINN.—At the annual meeting of the Northwestern Telephone Exchange Company, recently held in this city, the estimate for improvements to be made by the company during the year called for the expenditure of $1,200,000.

ROCHESTER, N. Y.—The securities of the Rochester Telephone Company have been purchased by the Continental Telephone and Telegraph Company, and the deal provides also for the financing of the Syracuse and Utica independent telephone companies. As the Continental Company has a lease of the Buffalo independent line, it will have a through line from Buffalo to Poughkeepsie, New Jersey, Pennsylvania and West Virginia, and will also have lines in Cleveland, St. Louis, Kansas City and other western points.

PENDLETON, ORE.—One of the most important telephone deals ever made in eastern Oregon was closed recently when the Interstate Telephone Company took over the system of the Eastern Indepenlent Telephone Company. The consideration was $50,000, and 200 miles of line changed hands. The purchasing company is better known as the Pilot Rock system. The independent company is better known as the Butter Creek Company, and supplies all the country between Pendleton and Heppner, having exchanges at Echo, Stanfield, Umatilla and Hermiston, besides connecting with the Pacific Company in Pendleton, Heppner and Umatilla. W. D. Delarm of Seattle and R. H. McWhorter are the president and secretary of the consolidated company.

BRISTOL, TENN.—The East Tennessee Telephone Company will install an entire new equipment in this city, which will involve an expenditure of probably $15,000.

MEMPHIS, TENN.—The Cumberland Telephone and Telegraph Company is planning to build a new branch exchange in the southern part of the city in order to take care of its growing business there and relieve the work at the main exchange. The building and its equipment will cost about $40,000.

BROWNSVILLE, TEX.—The entire system of the Brownsville Telephone Company, including the local exchange and 120 miles of long distance wires covering the entire lower Rio Grande valley, has been purchased by C. E. Wells of Kingsville, who also owns the Kingsville and Alise exchanges. The consideration was $30,000.

SEATTLE, WASH.—The Pacific Telephone and Telegraph Company will erect a new exchange at 6412 Twelfth Avenue Northeast, at a cost of $22,000.

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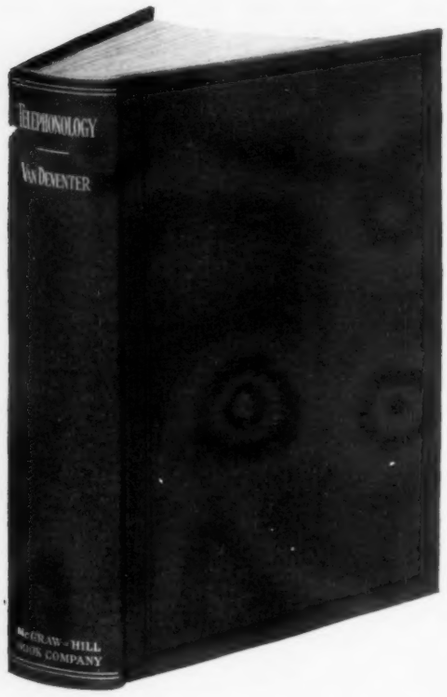

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